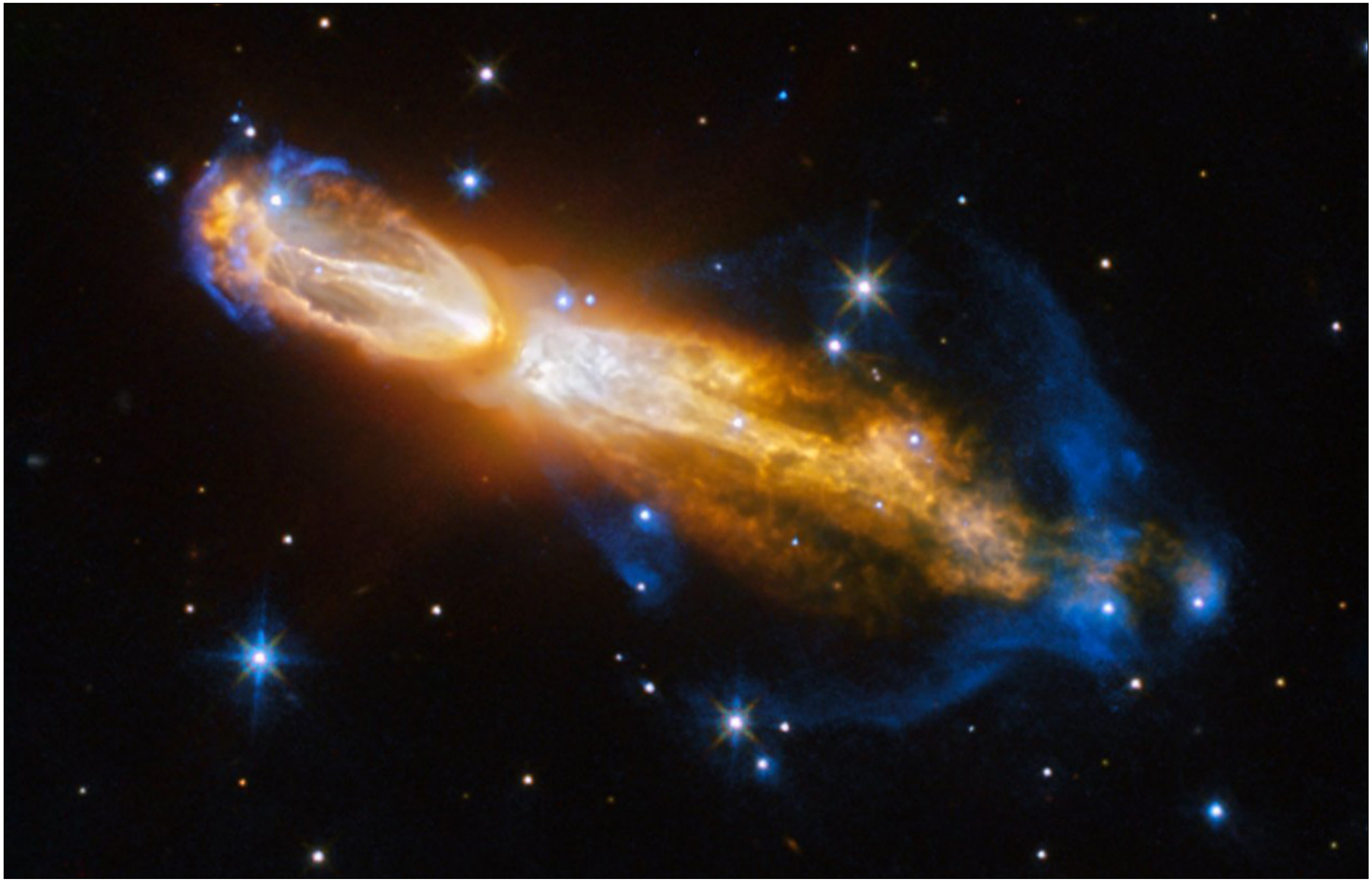
National Aeronautics and Space Administration



Calabash Nebula

Hubble Captures a Lopsided Nebula

This dramatic Hubble Space Telescope image captures an exquisite view of a brief phase at the end of a medium-mass star's life.

The picture shows a dying star undergoing a rapid transformation. The star has heated up and expanded in size, and is beginning to rapidly shed its outer layers of gas and dust. This dense material, shown in yellow-orange, is streaming away at about 600,000 miles per hour in two opposing directions. Much of the star's original mass is contained in the outflow.

The entire system measures 1.4 light-years across and is called the Calabash Nebula, named for the lopsided-looking calabash gourd. Like the gourd, the Calabash Nebula's shape is asymmetrical. One lobe of outflow material is uncharacteristically larger than the other.

The nebula is also known as the Rotten Egg Nebula, because the gaseous debris contains large amounts of sulfur, part of the mixture that gives rotten eggs their foul smell.

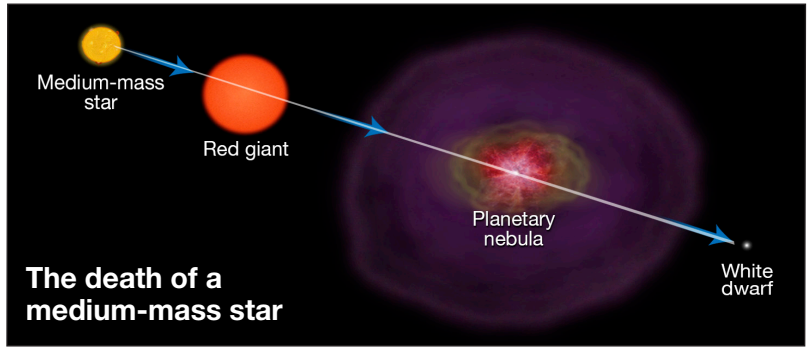
The blue-colored gas at each end of the gaseous outflow marks where the high-speed gas is ramming into material in the surrounding environment. The violent collisions create shock fronts, which heat the material to the point at which it glows. Although computer simulations had predicted the existence of such shocks fronts, observations before Hubble did not provide enough evidence for a definitive identification.

Astronomers rarely observe a star in this phase of its evolution because it occurs within the blink of an eye — in astronomical terms. Although stars live for billions of years, the ejection of material as they die takes only thousands of years.

Over the next millennium, the star will continue to shed its outer material, exposing a hot, dense stellar remnant called a white dwarf. The flood of ultraviolet light from the remnant will heat the gas in the surrounding nebula, causing it to glow. This glowing cloud of material, called a planetary nebula, will expand and grow fainter over tens of thousands of years.

The Calabash Nebula resides 5,000 light-years from Earth in the constellation Puppis.

Image credit: NASA and ESA
Acknowledgement: Judy Schmidt



This diagram illustrates the stages at the end of a medium-mass star's life. These stars shine for billions of years, powered by nuclear fusion of hydrogen in their cores.

When the hydrogen fuel is exhausted, the core shrinks, heats up, and ignites helium fusion. The outer layers of the star expand, and the star becomes a red giant, which is tens to hundreds of times larger than its previous size.

These stars are not massive enough to proceed beyond helium fusion, and they become unstable as their fuel runs out. The outer gaseous layers are shed into space, illuminated by radiation from the hot, exposed core. This glowing, gaseous object is called a planetary nebula, which expands and fades away over tens of thousands of years. The tiny core, now lacking a fuel source, shines brightly as a white dwarf and slowly cools for billions of years.

VOCABULARY

Star: A huge ball of gas held together by gravity. The central core of a star is extremely hot and produces energy. Some of this energy is released as visible light. Stars come in different sizes, colors, and temperatures.

White dwarf: The hot, compact remains of a star that has exhausted its sources of fuel for nuclear fusion in its core.

Nuclear fusion: The process by which multiple atomic nuclei join together to form a heavier nucleus. When light nuclei combine to form heavier nuclei, energy is released. This energy is what powers stars like our Sun.

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