What is a supernova?

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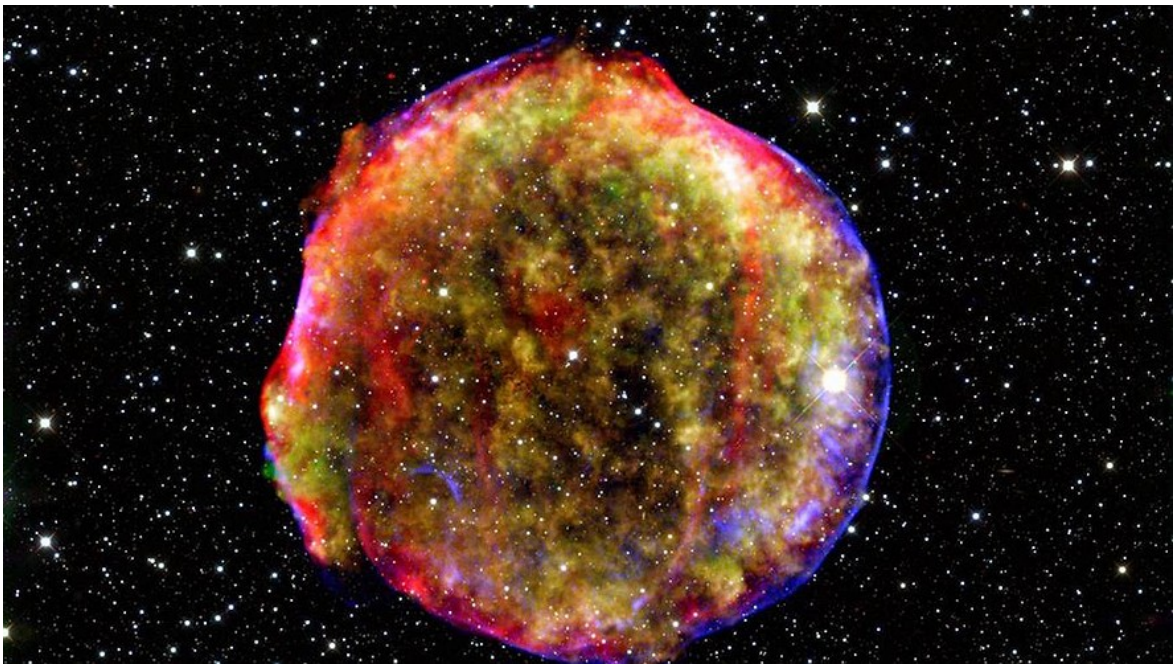

TOP: A vivid view of a supernova remnant captured by NASA's Spitzer and Chandra space observatories and the Calar Alto observatory in Spain. Photo: MPIA/NASA/Calar Alto Observatory. BOTTOM: NASA's Hubble Telescope captured an image of Eta Carinae, one of the closest stars to Earth that is likely to explode in a supernova in the "relatively near future." In astronomical timescales, that "near future" could still be a million years away. Photo: ESA/NASA NASA.gov.

A supernova is the explosion of a star. It is the largest explosion that takes place in space.

Supernovas are among the most powerful and spectacular events in the universe. Most of the changes that take place in the universe happen very, very slowly in human terms. For example, it took millions of years for our solar system to form, and 4.5 billion years more for intelligent life to evolve on one of its planets. Our sun is still only about halfway through its expected lifetime. A supernova, though, happens in only about 15 seconds.

Explosions In The Sky

Supernovas are often seen in other galaxies, but they are difficult to see in our own Milky Way galaxy because interstellar dust blocks our view. In 1604, the German astronomer Johannes Kepler discovered the last observed supernova in the Milky Way. In 2008, NASA’s Chandra telescope discovered a more recent supernova, which exploded in the Milky Way more than a hundred years ago.

Supernovas are not very common. Astronomers believe that in galaxies like ours, about two or three supernovas occur each century. Because the universe contains so many galaxies, astronomers observe a few hundred supernovas per year outside our galaxy. These fantastic events can be so bright they outshine their entire galaxy for a few days or even months.

Astronomers know enough about how stars age to predict when a star will become a supernova, and they know that none of the stars in our part of the Milky Way galaxy will explode any time soon.

Lights Out In 15 Seconds

A supernova happens where there is a change in the core, or center, of a star. A change can occur in two different ways, with both resulting in a supernova.

The first type of supernova happens in binary star systems. Binary stars are two stars that orbit the same point. One of the stars steals matter from another. Eventually, this star gets too big and explodes, resulting in a supernova.

The second type of supernova occurs at the end of a single star's lifetime. As a star runs out of fuel, some of its mass flows into its core, making the core heavier and heavier. Eventually, the core becomes too heavy not to collapse. This collapse results in the giant explosion of a supernova. Our sun is a single star, but it does not have enough mass to become a supernova.

A star is a balancing act between two huge forces. The star's own gravity tries to squeeze itself into the smallest and tightest ball possible. At the same time, the tremendous heat and pressure from the fires burning at the star's center try to push all that material outward. When the star has used up all of its fuel, the outward pressure is no longer as strong as the gravity, and the star suddenly collapses. Imagine something one million times the mass of Earth collapsing in 15 seconds! The collapse of the core happens so fast that it makes enormous shock waves that blow the outer part of the star into space at 50 million miles per hour!

Usually, a very dense core is left behind, along with an expanding cloud of gas, called a nebula. Stars that are more than about 10 times the size of our sun may leave behind the densest objects in the universe: black holes.

Key To Understanding The Universe

A supernova burns for only a short period of time, but it can tell scientists a lot about the universe. For example, one type of supernova has shown scientists that our universe is growing at an ever increasing rate.

Scientists have also determined that supernovas play a key role in distributing elements throughout the universe. When the star explodes, it shoots elements and debris into space. Many of the elements we find here on Earth are made in the core of stars. These elements travel on to form new stars, planets and everything else in the universe.

The massive stars that become supernovas are factories for producing and distributing all the raw materials needed to make everything else. Inside their cores, nuclear reactions create nearly all the atoms that make up planets, moons, asteroids and us. The carbon in your proteins, calcium in your bones, oxygen you breathe, iron in your blood, and almost all the other atoms in your body were manufactured inside a star! But ordinary stars don't get hot enough to make any atoms heavier than iron. To make heavier elements like gold, silver, lead, and mercury requires the very special conditions of pressure and heat that exist inside a supernova during those few seconds of the collapse. Then, the explosion flings all those elements into space.

Eventually, this material collects and forms a new star and new planets. That new solar system then is fully supplied with all the resources it needs for making planets like Earth, as well as all the ingredients that can make plants and animals.

New Ways To Find Supernovas

NASA scientists use different types of telescopes to look for and study supernovas. Some telescopes are used to observe the visible light from the explosion, while others record information from electromagnetic radiation that is produced by the supernova.

In June 2012, NASA launched an orbiting telescope called NuSTAR, which will look for collapsed stars, black holes and the remains of supernovas. Scientists hope to learn more about how stars explode and the elements that are created by supernovas.

You do not have to be a scientist, or even have a telescope, to hunt for supernovas. For example, in 2008 a teenager discovered a supernova. Then in January 2011, a 10-year-old girl from Canada discovered a supernova while looking at night sky images on her computer. The images, taken by an amateur astronomer, just happened to include a supernova.

Quiz

1 Read the following sentence from the section "Explosions In The Sky."

> *Supernovas are often seen in other galaxies, but they are difficult to see in our own Milky Way galaxy because interstellar dust blocks our view.*

Which sentence from the article BEST supports the statement above?

(A) Most of the changes that take place in the universe happen very, very slowly in human terms.

(B) In 1604, the German astronomer Johannes Kepler discovered the last observed supernova in the Milky Way.

(C) Astronomers believe that in galaxies like ours, about two or three supernovas occur each century.

(D) The star's own gravity tries to squeeze itself into the smallest and tightest ball possible.

2 Which section of the article BEST explains why supernovas occur?

(A) "Explosions In The Sky"

(B) "Lights Out In 15 Seconds"

(C) "Key To Understanding The Universe"

(D) "New Ways To Find Supernovas"

3 The central idea of the article is developed by:

(A) describing the causes of supernovas and their effects throughout the universe

(B) discussing the different methods that scientists use to observe supernovas

(C) detailing the weight and diameter of stars that will become supernovas

(D) debating whether or not a supernova will occur any time soon in the Milky Way galaxy

4 Read the following sentence from the section "Lights Out In 15 Seconds."

> *Stars that are more than about 10 times the size of our sun may leave behind the densest objects in the universe: black holes.*

Does this sentence support a central idea of the article? Why or why not?

(A) Yes, it explains how the sun may leave a black hole behind one day, which is supported later in the article.

(B) No, it introduces black holes, which are not discussed in the remainder of the article.

(C) Yes, it describes a potential result of a supernova, which relates to the topic of the article.

(D) No, it does not contain any mention of supernovas, which are the focus of the article.