COMMONLIT

Name: _____ Class: _____

When Stars Explode

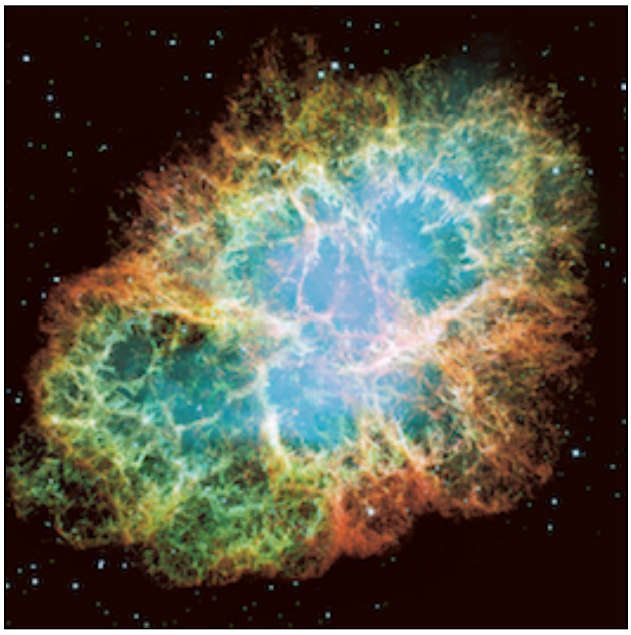
By Ken Croswell, Ph.D
2016

In this informational text, Ken Croswell discusses why stars explode and what happens when they do. As you read, take notes on how star explosions impact the rest of the universe.

[1] All your friends warned you to stay away from Antares — a big red star in the constellation[1] Scorpius. Someday, they said, Antares would explode.

But you didn't listen. You wanted to visit this supergiant star. Antares is so big that if it were at the center of our solar system, it would swallow Mercury, Venus, Earth, and Mars.

Now, as your spaceship comes within a few trillion miles of Antares, your neutrino detector sounds an alarm. A big burst of neutrinos is passing through your ship. Neutrinos are tiny particles of matter — they don't hurt you, because they pass harmlessly through everything in their path — but you know what they mean: Antares is about to explode! Quickly you fire your rockets and escape, just as Antares outshines every other star in the galaxy.



"In the year 1054, people saw a star explode in the constellation Taurus. Much later, astronomers used telescopes to discover this expanding cloud of debris. It is called the Crab Nebula. It is a supernova remnant - the remains of an exploded star." by Photo courtesy of NASA/ESA/JPL/Arizona State University is used with permission.

When a Star Dies

The explosion is a supernova, the spectacular death of a star. The last time people saw a supernova in our galaxy was 1604. That was before astronomers were using telescopes. However, every year astronomers see supernovae exploding in other galaxies. Astronomers can often observe such supernovae for months before they fade from view.

[5] Most supernovae — that's the plural of supernova and pronounced SOO-per-NOH-vee — come from massive stars. Antares is a massive star. Such a star is born with more than eight times the mass of the Sun.

When a massive star is young, it is hot, bright, and blue. Its center makes energy the same way the Sun does: by changing hydrogen, the lightest element, into helium, the second-lightest element. This nuclear reaction creates energy that heats the star and makes it shine.

1. a group of stars forming a recognizable pattern

The outflow of huge amounts of energy — much of it light — pushes outward from the star's center. This is good, because the force of gravity pulls inward and tries to make the star collapse. But as long as the star can make energy, it can fight the force of gravity and survive.

However, a massive star must make lots of energy to fight the gravity of its own mass. So the star shines very brightly. As a result, we can easily see the star across hundreds of light-years of space. This is a huge distance, because one light-year is the distance that light speeds through in a year: nearly 6 trillion (6,000,000,000,000) miles.

But because the star shines so brightly, it uses up its hydrogen fuel within millions of years — much less time than the *billions* of years the Sun will take to use up its fuel. Soon the star's center runs out of hydrogen. Then the star expands and cools, turning into a big red star like Antares. Astronomers call such a star a red supergiant.

[10] The red supergiant makes energy by changing helium and other elements into still heavier elements. But these nuclear reactions do not make as much energy as hydrogen did. Within a few million years, the star has no fuel left.

Now the star is in big trouble. The star can't make energy to hold itself up, and gravity is still trying to pull the star inward. So the star's center collapses, scrunching itself into a small, dense[2] object. Meanwhile, the star's outer layers shoot into space at millions of miles per hour. The star has exploded!

Our Sun Won't Blow Up

Supernovae are violent, but we do not have to worry. The Sun will never explode. If a supernova occurred within a few dozen light-years of Earth, we would be in trouble. But the nearest star that will explode is more than a hundred light-years away.

Believe it or not, supernovae help life. In fact, without them, the Earth would not exist. Neither would we.

In the year 1054, people saw a star explode in the constellation Taurus. Much later, astronomers used telescopes to discover this expanding cloud of debris.[3] It is called the Crab Nebula. It is a supernova remnant — the remains of an exploded star.

[15] Here's why. When the universe began, it had only the three lightest elements: hydrogen, helium, and a little lithium. But life needs heavier elements, such as oxygen, which we breathe, and iron, which is in our blood. And the Earth is made mostly of oxygen, silicon, and iron.

Almost all oxygen came from massive stars, like Antares. During their lives, massive stars cause helium nuclei to join together to make oxygen. Then, when the stars explode, they cast this oxygen into space. And the explosions themselves make iron. In fact, scientists think supernova explosions made most of the iron in the universe.

2. closely compacted together
3. **Debris** ***(noun):*** the remains of something that has been destroyed or broken up

How did these vital[4] elements get from the supernovae to our planet — and even into our bodies? Billions of years ago, before the Earth was born, supernovae cast oxygen and iron into space. These elements drifted through the galaxy. They became part of a cloud of gas and dust that contained other elements. This cloud gave birth to the Sun and the Earth. You are made of those atoms now.

So even though a supernova means a star has died, it also marks the birth of elements that support life.

4. **Vital** ***(adjective):*** absolutely necessary or important

Text-Dependent Questions

Directions: For the following questions, choose the best answer or respond in complete sentences.

1. PART A: Which TWO statements identify the central ideas of the text?
    A. Supernovae are violent events in space, but essential for life to succeed.
    B. Supernovae destroy life as much as they create it with their explosions.
    C. Eventually, life on Earth will be ended by the explosion of the Sun.
    D. Every star eventually runs out of fuel and dies in a large supernova explosion.
    E. Earth would benefit from a nearby supernova to provide it with additional elements.
    F. When large stars run out of fuel and surrender to gravity, they explode in a supernova.

2. PART B: Which TWO details form the text best support the answers to Part A?
    A. “Antares is so big that if it were at the center of our solar system, it would swallow Mercury, Venus, Earth, and Mars.” (Paragraph 2)
    B. “Its center makes energy the same way the Sun does: by changing hydrogen, the lightest element, into helium, the second-lightest element.” (Paragraph 6)
    C. “This is good, because the force of gravity pulls inward and tries to make the star collapse. But as long as the star can make energy, it can fight the force of gravity and survive.” (Paragraph 7)
    D. “If a supernova occurred within a few dozen light-years of Earth, we would be in trouble. But the nearest star that will explode is more than a hundred light-years away.” (Paragraph 12)
    E. “Believe it or not, supernovae help life. In fact, without them, the Earth would not exist. Neither would we.” (Paragraph 13)
    F. “When the universe began, it had only the three lightest elements: hydrogen, helium, and a little lithium.” (Paragraph 15)

3. PART A: Which statement best describes Antares in the text?
    A. Antares is a made-up star that the author uses to discuss supernovas.
    B. Antares is the last supernova that was observed in our galaxy.
    C. Antares is a large star that will likely result in a supernova when it dies.
    D. Antares is a star that died in a supernova that the author witnessed.

4. PART B: Which section from the text best supports the answer to Part A?
    A. “Antares is so big that if it were at the center of our solar system, it would swallow Mercury, Venus, Earth, and Mars.” (Paragraph 2)
    B. “Now, as your spaceship comes within a few trillion miles of Antares, your neutrino detector sounds an alarm.” (Paragraph 3)
    C. “The explosion is a supernova, the spectacular death of a star. The last time people saw a supernova in our galaxy was 1604.” (Paragraph 4)
    D. “Most supernovae — that’s the plural of supernova and pronounced SOO-per-NOH-vee — come from massive stars. Antares is a massive star.” (Paragraph 5)

5. What is the relationship between supernovae and life on Earth?

Discussion Questions

Directions: Brainstorm your answers to the following questions in the space provided. Be prepared to share your original ideas in a class discussion.

1. The text explores how supernovas produce certain elements in the universe. How does this support the idea that nature is in control? Where would humans be without the supernovae that resulted in heavier elements in the universe?

2. The text explains how astronomers study supernova. How do you think studying supernovae helps scientists better understand Earth and the rest of the universe? Have you ever studied the sky or space? What did you learn? Would you be interested in seeing a supernova? Why or why not?