AND NOW . . . THE LIVES OF THE STARS!

Path of the Sun

(And other stars as massive as the Sun)

MAIN PHASE

10 billion years

For most of its life, the Sun (and other stars with a mass like the Sun) shines steadily. At its core, nuclear reactions are burning hydrogen and converting it to helium. The Sun takes about 10 billion years to use up the hydrogen in its core: It is now about halfway through.

RED GIANT

2 billion years

When the star's hydrogen runs out, gravity causes its core to shrink and get hotter. The cooler outer layers expand and glow red. The star becomes a red giant. It now burns helium at its core. When this runs out, gravity once again causes the core to collapse.

Path *of* Massive Stars

(Stars 10-50 times as massive as the Sun)

MAIN PHASE

1-20 million years

Stars more massive than the Sun live fast and die young. They burn through their hydrogen fuel in less than 20 million years. Initially they are blue and shine much hotter and brighter than the Sun and other sun-like stars as they race toward the end of their lives.

RED SUPERGIANT

2-5 million years

As a massive star runs out of hydrogen, it begins to expand. Its core heats up while the outer layers cool and glow red. At its core, the red supergiant burns its helium to make other elements, including carbon and oxygen. Eventually it begins to make iron, the heaviest of elements.

SUPERNOVA

Immediate; glows brightly for several months

Iron absorbs energy rather than releasing it. In a split second, the star collapses under its own mass, condensing its core into a dense nucleus. The nucleus reacts to the squeezing by releasing massive shock waves, exploding the star into a supernova. A supernova can shine brighter than 1 billion Suns.

The Sun is the largest body in the solar system, but it is also a star—a pretty average star. Out in the universe the Sun is one of millions of stars. Like all stars, the Sun went through many complex changes after it was born. This took over hundreds of thousands of years. Once a star is formed, its mass will determine how long it shines and what happens during the rest of its life.

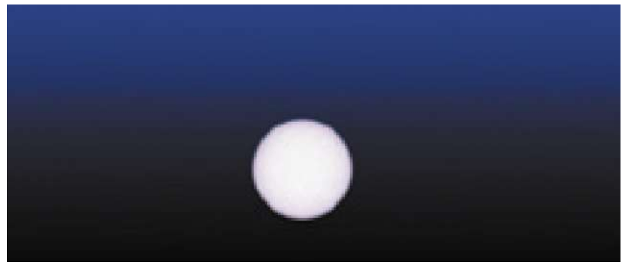
For example we know that our Sun will become a red giant in 5 billion years. But there's more to come . . . it's got a long life ahead!

The timeline below shows several paths a star can take. The first is the Sun's path. (Stars with the same mass as the Sun also follow this path.) The second path is for stars more massive than the Sun. Of course, our Sun will eventually burn up and disappear from view, like many stars. But don't worry—that's a long way away!

PLANETARY NEBULA

A few thousand years

Heat from the collapsing core is transferred to the red giant's outer layers, causing a final reaction that blasts off the star's outer layers. A shell of material drifts outward into space, leaving a glowing core. Light from the core often illuminates the cast-off material, which is a planetary nebula. Early astronomers thought they looked like disks of planets.



WHITE DWARF

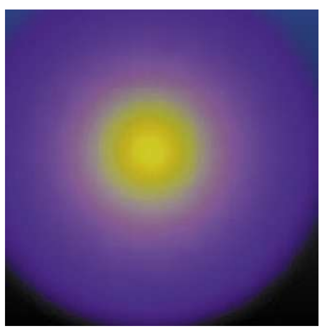
Fades slowly

Only the core of the original star remains. It glows for a long time as a white dwarf, shining weakly. When it loses the last of its heat, it becomes a black dwarf and disappears from view.

NEUTRON STAR

Stars 10-30 times as massive as the Sun

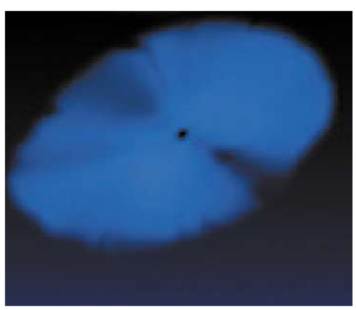
The core that remains becomes a star made of neutrons, which are extraordinarily dense. A teaspoon full of neutron star material weighs about 10 billion pounds, roughly the weight of the Sears Tower in Chicago, Illinois.



BLACK HOLES

Stars 30-50 times as massive as the Sun

Sometimes the core that remains after a supernova is so massive that nothing can support it against its own gravity. It collapses into itself and becomes a black hole. Gravity is so strong in a black hole that nothing—not even light—can escape.



Activity

GRAVITY WELLS Gravity affects how stars are formed. This demonstration shows you how star formation works.

Materials:

- 2 shallow bowls (of different sizes)
- bag of sand
- newspaper

Spread out the newspaper and place the two bowls on it. Pour out the sand in a wide swath, so that it falls into and around each of the bowls.

1. What happens to the sand in the bowls?
2. What do you think the sand outside the bowls represents?
3. How does the size of the bowl affect the outcome?

Check out the answers on page 32.