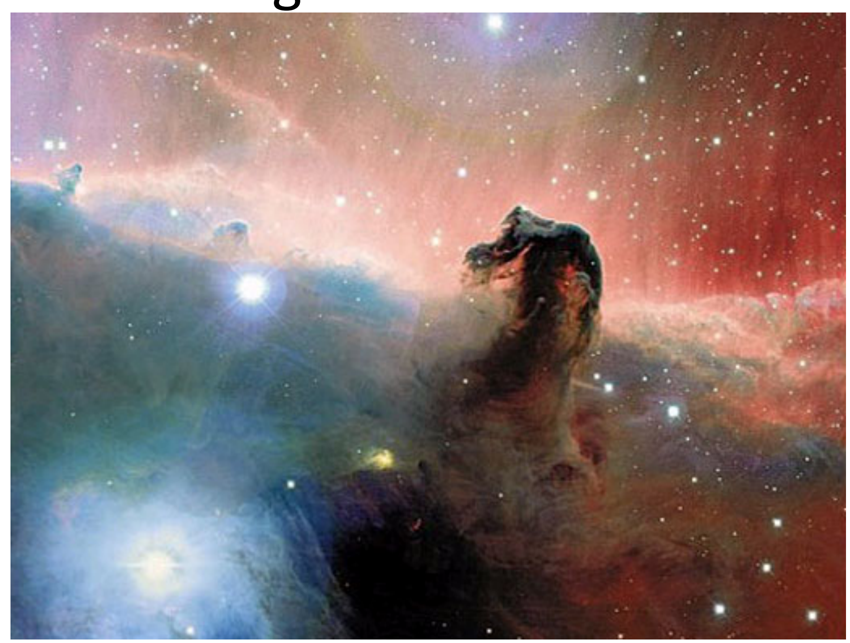
Nebula

A nebula is a cloud of gas and dust in outer space that is considered to be a “stellar nursery.” Most nebulae aren’t visible without powerful microscopes, but the Orion Nebula, shown here, can be seen with the naked eye.

The Orion Nebula is 1,500 light years away, which means that the light leaving the nebula takes 1,500 years to reach us. Which means that if you see it in the night sky, you’re actually seeing what it looked like 1,500 years ago. Thousands of stars are forming in this nebula.

One part of this Orion Nebula is the Horsehead Nebula, shown on the right. It looks awesome.



Average Star

Stars are different masses, temperatures, and colors. A star the size of our Sun requires about 50 million years to mature from the beginning of the collapse to adulthood. Our Sun will stay in this mature phase for approximately 10 billion years.

Stars are fueled by the nuclear fusion of hydrogen to form helium deep in their core. The leftover energy creates photons, which emits the light we see.

Our Sun, the star closest to us, is a totally normal star. Light from the Sun takes about eight minutes to reach Earth, while the light from the next nearest star takes a several years to reach us. Our Sun is about 4.5 billion years old, now about halfway through its middle age. It will continue to give us light and heat for another 5 billion years. How long a star lasts depends on how big it is. Smaller stars burn calmly for hundreds of millions of years and die much more quietly.

Red Giant Star

A red giant star is a dying star in the last stages of stellar evolution.

Eventually, a star runs out of hydrogen to fuse in its core, which means it runs out of energy to burn. When that happens, the star begins to contract under its own gravity. This free-fall contraction eventually generates enough pressure and heat to start fusion in a shell around the core. The sudden restart of fusion generates an outward force that makes the star swell. The newly formed red giant has an inflated atmosphere, a dense helium core, and a radius even hundreds of times larger than the original star.

In approximately 5 billion years, our Sun will turn into a red giant star. When it expands, its outer layers will consume Mercury and Venus, and reach Earth. Scientists are still debating whether or not our planet will be engulfed or not. Either way, life as we know it on Earth will cease to exist.

Planetary Nebula

As a low mass star approaches the end of its life, it begins to use up the last of its fuel. Initially, it will use up all of its hydrogen. When this happens, the star expands into a red giant and begins burning helium. As the red giant burns through its helium supply, inert carbon begins building up at the star's core. When the last of the helium has been used, the star sheds its outer layers into space, leaving the small inert carbon core at the center of a huge cloud of dust. Energy from the cooling carbon core energizes the dust cloud, making it glow. This is the birth of a planetary nebula.

White Dwarf

As the star evaporates in the red giant phase, it leaves behind its core. In the white dwarf state, all the material contained in the star, minus the amount blown off in the red giant phase, will be packed into a volume one millionth the size of the original star. An object the size of an olive made of this material would have the same mass as an automobile! The combined pressure of the electrons holds up the white dwarf, preventing further collapse towards an even stranger entity like a neutron star or black hole.

The infant white dwarf is incredibly hot. It will eventually release all its heat and become known as a black dwarf, but our universe isn't old enough for any of those to exist yet.

Massive Star

There are trillions upon trillions of stars in the universe. Some are only a fraction of the Sun's mass, while others are equivalent to hundreds of Suns. Current theory says that a star's mass can only be about 120 times that of our Sun. Beyond this, scientists don't understand how a star remains stable. Yet they have discovered starts larger than that.

While normal stars burn slowly and regularly for long periods of time, massive stars burn faster and hotter and die more quickly.

Red Supergiant

A red supergiant star is a dying star in the last stages of stellar evolution. It's basically the same as a red giant:

Eventually, a star runs out of hydrogen to fuse in its core, which means it runs out of energy to burn. When that happens, the star begins to contract under its own gravity. This free-fall contraction eventually generates enough pressure and heat to start fusion in a shell around the core. The sudden restart of fusion generates an outward force that makes the star swell. The newly formed red giant has a tenuous and inflated atmosphere, a dense helium core, and a radius even hundreds of times larger than the original star.

Supernovae

A supernova is the explosion of a star. It is the largest explosion that takes place in space. As the star runs out of nuclear fuel, some of its mass flows into its core. Eventually, the core is so heavy that it cannot withstand its own gravitational force. The core collapses, which results in the giant explosion of a supernova. Only massive stars can die in a supernova.

A supernova burns for only a short period of time, but it can tell scientists a lot about 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.

Black Hole

If the stellar core is too big, it collapses on itself, resulting in a great amount of matter packed into a very small area - think of a star ten times more massive than the Sun squeezed into a sphere approximately the diameter of New York City. The result is a gravitational field so strong that nothing, not even light, can escape.

Scientists can't directly observe black holes with telescopes. They can, however, infer the presence of black holes and study them by detecting their effect on other matter nearby. If a black hole passes through a cloud of interstellar matter, for example, it will draw matter toward it. A similar process can occur if a normal star passes close to a black hole. In this case, the black hole can tear the star apart.

Black holes can be big or small. Scientists think the smallest black holes are as small as just one atom. These black holes are very tiny but have the mass of a large mountain. The largest black holes are called "supermassive." Scientists have found proof that every large galaxy contains a supermassive black hole at its center." --NASA

Neutron Star

If the collapsed stellar core is large (but not too large), it becomes a neutron star. These interesting objects are born from once-large stars that grew to four to eight times the size of our own sun before exploding in catastrophic supernovae. After such an explosion blows a star's outer layers into space, the core remains—but it no longer produces nuclear fusion. With no outward pressure from fusion to counterbalance gravity's inward pull, the star condenses and collapses in upon itself.

Despite their small diameters—about 12.5 miles (20 kilometers)—neutron stars boast nearly 1.5 times the mass of our sun, and are thus incredibly dense. Just a sugar cube of neutron star matter would weigh about one hundred million tons on Earth.

Neutron stars pack an extremely strong gravitational pull, much greater than Earth's. This gravitational strength is particularly impressive because of the stars' small size.