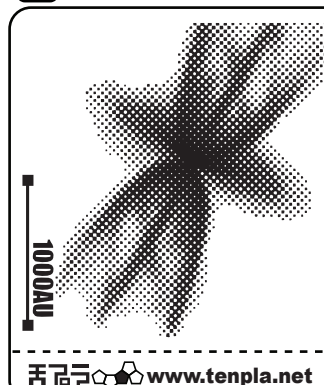


1. Molecular Cloud

Even in the near "vacuum" of outer space, low density gas exists. A denser part of the gas is called a molecular cloud (dark cloud). Stars are born in a molecular cloud that absorbs light. Due to its self-gravity, a molecular cloud collapses and splits into fragments. A dense part of a fragment is called a molecular cloud core; an "egg" of stars.

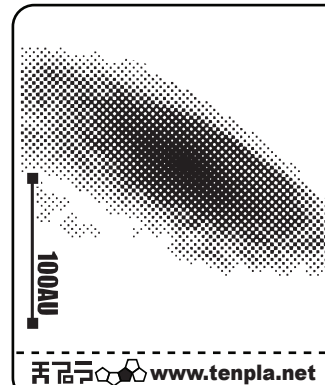


The size of an object in each figure is shown in Astronomical Units (AU). One AU is the distance between the Sun and Earth (93million miles/150million km). Pluto is 40AU away, and the nearest star is 270,000 AU away from the Sun.



2. Protostar

A molecular cloud core, an "egg" of stars, collapses because of its self-gravity, and baby stars (protostars) are born. Different from the Sun and other "adult" stars, nuclear fusion reaction has not started yet. The surrounding gas and dust fall into a disk around the star and then falls into the star. The protostar is getting heavier and heavier. The gas is also blown off as "jets".



3. T Tauri Star + Proto-Planetary Disk

When the falling gas and dust disappear from around a proto-star, you can see the baby star as if the Sun came out from a cloud. The gas and dust still go around a star as a disk, which is called a proto-planetary disk. Planets such as Earth and Jupiter are thought to be formed from a proto-planetary disk. A visible baby star with a gas-and-dust disk is called a T Tauri star.



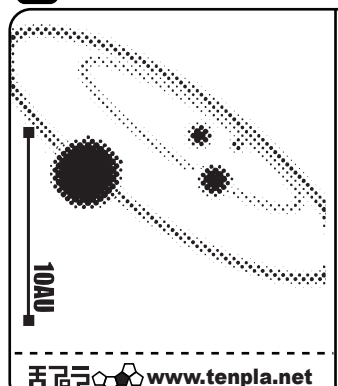
Astronomers use not only visible light but also "invisible" light such as radio, infrared, UV, and X-ray which are all electromagnetic waves. Observations in various waves are essential to figure out various phenomena.



Beautiful stars in the night sky have their own births and deaths. They are born from gas and die ejecting gas into space, which creates the next generation of stars. This toilet paper explains the life of a star as heavy as the Sun.

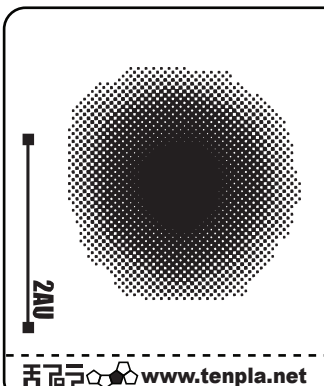


Planets outside of the Solar System are already found at more than 100 stars. The known planets are all giant ones like Jupiter, however, small planets like Earth may be found soon with improvements in observational instruments.



4. Main sequence star + planetary system

Finally a star reaches the stable phase, the main sequence, like the Sun. Nuclear reactions near its center produces star light. The lifetime of a star depends on its weight. A heavier star dies earlier, and a lighter star lives longer. A star with Sun's weight lives for 10 billion years. The Sun is now 5 billion years old and planets are already formed from gas and dust.



5. Red Giant

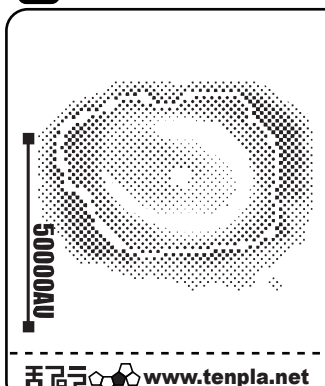
When a star burns out its hydrogen, the fuel near the center, it expands. At the same time, the surface temperature goes down and the color of the star turns red. This phase is called a red giant. Antares, at the heart of Scorpius, and Betelgeuse, in the left arm of Orion are typical red giants.



About 5 billion years later the Sun will get old and become a red giant. At that time the surface of the Sun will reach to the orbit of our Earth. Then the Sun becomes a planetary nebula and ends its 10-billion-year life.



A white dwarf is at the center of a planetary nebula. Its surface temperature is several tens of thousands of degrees C at first and then it cools off. The gas is expanding into space at several tens of kilometers per second.



6. Planetary Nebula

In case of not-so-heavy stars like our Sun, a red giant star becomes unable to hold gas under its gravity, and the outer surface keeps expanding. The expanding gas is called planetary nebula. The gas which returns to space will be the material of next generation stars and planets.

Your body and this toilet paper were made from remnants of a star.