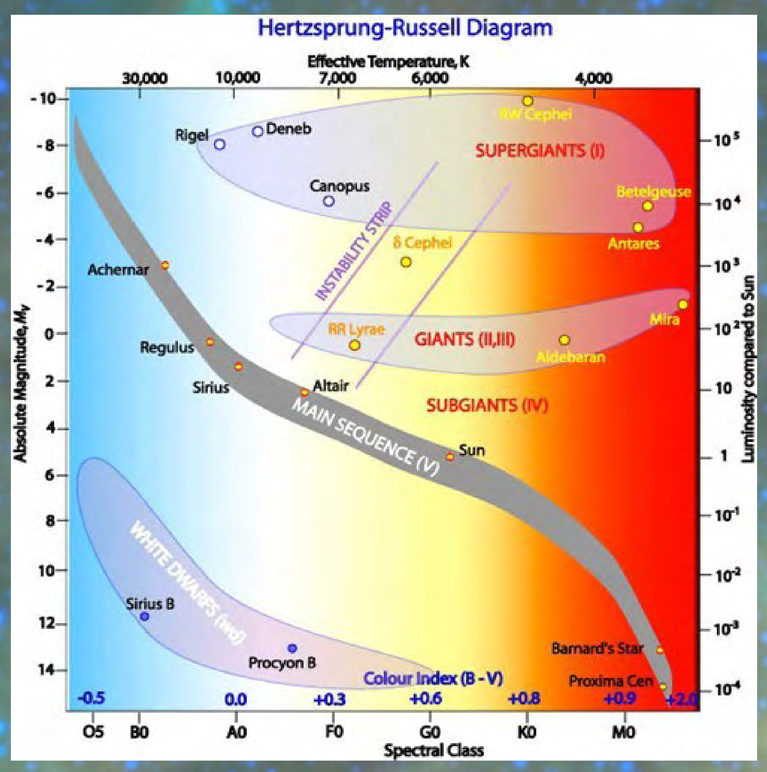
Types of Stars

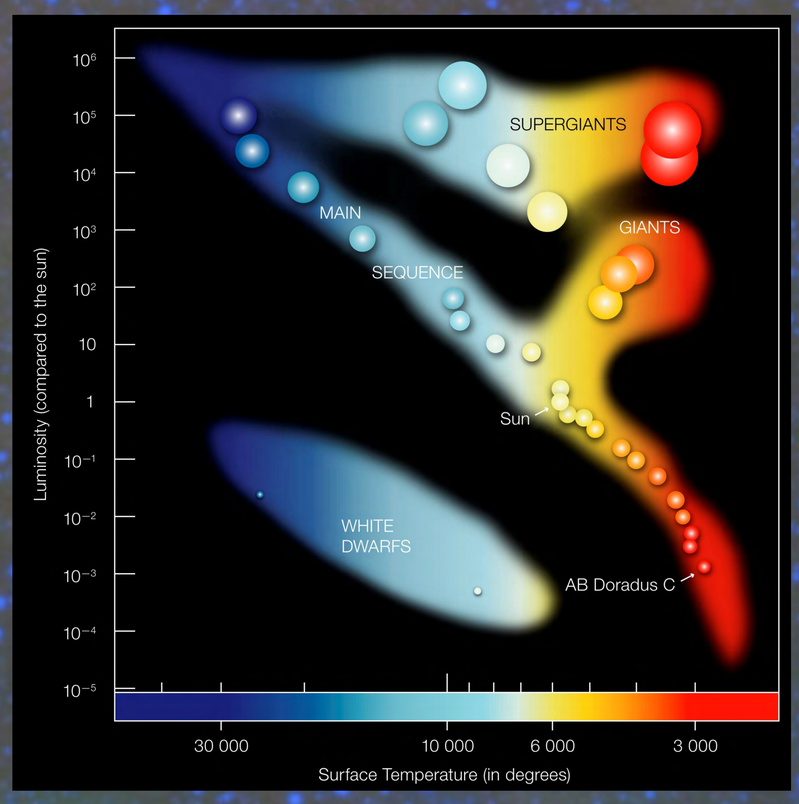
Spectral Classification: Based on the luminosity and effective temperature , the stars are categorized depending upon their positions in the HR diagram.



Hertzsprung - Russell Diagram
(H-R Diagram)

The H-R Diagram is a graphical tool that astronomers use to classify stars according to their luminosity (i.e. brightness), spectral type, color, temperature and evolutionary stage.

The H-R diagram is a plot of the luminosity of stars versus their effective temperature. Most of the stars occupy the region in the diagram along the line called the main sequence. During that stage stars are fusing hydrogen in their cores. Other parts of the H-R Diagram feature stars in other stages of evolution, like red giants and white dwarfs.



Various Types of Stars

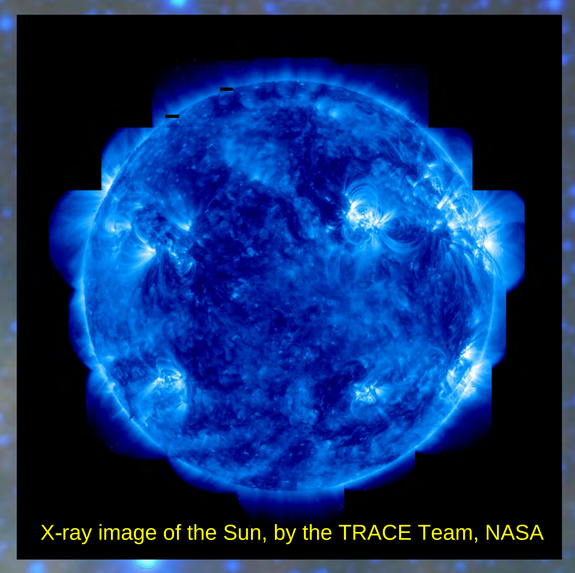
Protostars

A protostar forms by gravitational collapse from the gas of the interstellar medium, triggered by disturbances, e.g. shock waves. The temperature of the cloud increases as the cloud contracts, its opacity increases and it is difficult to observe directly. The protostar takes about 100000 years to reach the main sequence.


The protostar Herbig-Haro 46/47

Main Sequence Stars, e.g. The Sun

Our Sun is an ordinary, main sequence star which is fusing hydrogen into helium at its core. It is around 4.5 billion years old, and is around halfway through its lifetime. It is expected to evolve into a red giant and subsequently into a white dwarf.


X-ray image of the Sun, by the TRACE Team, NASA


Infrared image of the red giant star U Hydrae, located 500 light years away from us.

Red giants

When stars like our Sun reach the end of their life, by exhausting the supply of hydrogen at their cores, they enter one last phase of ballooning up to many times of their original size. Such objects are called red giant stars. Such stars have radii ten to hundreds of times larger than that of the Sun. Our own Sun, for example will grow so large that it will engulf the orbits of Mercury, Venus and even Earth.

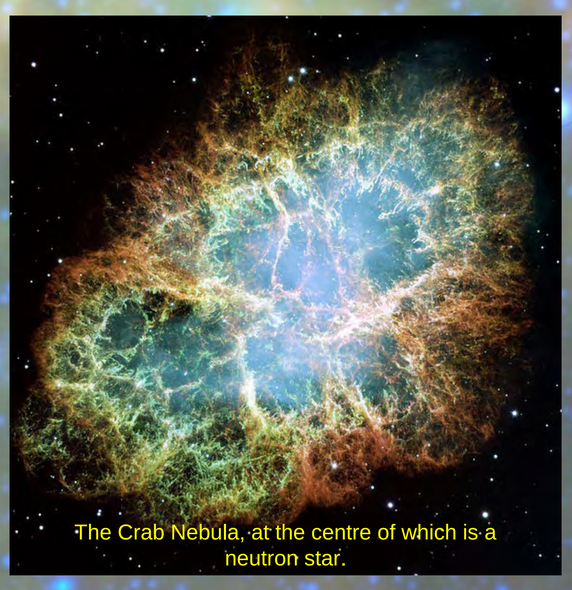

The blue supergiant, Eta Canis Majoris.

Blue Supergiants

These are classified on the upper left of the H-R diagram. They have extremely high luminosities and surface temperatures. They also have high mass loss rates and are unstable. Due to this, their lifetimes are short, and they are mainly observed in young open clusters and spiral arms of galaxies.

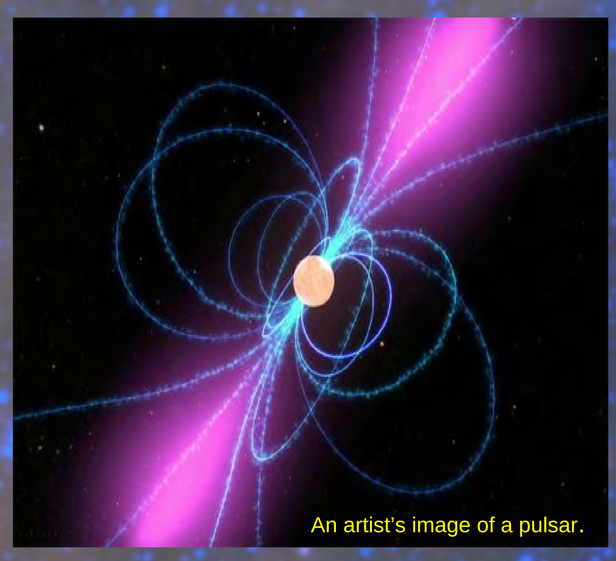
Neutron Star

Neutron stars are formed when a massive star dies in a "supernova explosion". During this dramatic event, the core of the star suddenly collapses under its own weight and the outer parts are violently ejected into surrounding space. A typical neutron star is the size of a small city. A spoonful of material form such a star, on Earth, would weigh as much as all the cars on Earth put together.


The Crab Nebula, at the centre of which is a neutron star.

Pulsars

Pulsars are spinning neutron stars that have jets of particles, beamed along magnetic poles, moving almost at the speed of light. This beam of light from the jets sweeps around as the pulsar rotates, just as the spotlight in a lighthouse does, hence pulses of radiation are seen as the beam sweeps over the Earth.


An artist's image of a pulsar.


The Helix Nebula, located about 700 ly away, hosts a white dwarf at the centre.

White Dwarfs

After a star like the sun exhausts its nuclear fuel, it loses its outer layer as a "planetary nebula" and leaves behind the remnant "white dwarf" core. Stars with initial masses less than 8 times the mass of the Sun will end as white dwarfs. A typical white dwarf is about the size of the Earth. It is very dense and hot. A spoonful of white dwarf material on Earth would weigh as much as a few tons. The image is of the Helix nebula, towards the constellation of Aquarius, which hosts a White Dwarf star at the centre.


Simulated image of a black hole.

Black Holes

Black holes are the evolutionary endpoints of very massive stars that undergo a supernova explosion, leaving behind a burnt out stellar remnant.

With no outward forces to oppose gravitational forces, the remnant collapses in on itself. The object left behind has such strong gravity that its escape velocity is greater than the speed of light. It means that not even light can escape from a black hole.