A Universe of Dwarfs and Giants

By Paul O'Neill, Education Support Officer

A star is basically a big ball of very hot hydrogen, with some helium and small amounts of a few other things. We know this from studying their spectra (see last issue of Astronotes). However, although they are made of basically the same stuff they are not all the same. Scientists love to classify things and one way to classify stars is by their different spectral types. The first attempt to do this was by Angelo Secchi in the 1860s; he divided stars into five different groups. This system was modified, refined, reworked etc.. several times; eventually ending up with the system we use today. One consequence of this process is the apparently random letters used for the names of the groups:

OBAFGKM

There are various mnemonics to help remember this list, for example:

Oh Be A Fine Girl Kiss Me.

My favourite variation on this is:

Only Boring Astronomers Find Gratification Knowing Mnemonics

When we gather together lots of information on stars and plot a graph of spectral type against intrinsic brightness (i.e. how bright a star really is) we get the diagram at the top of the page.

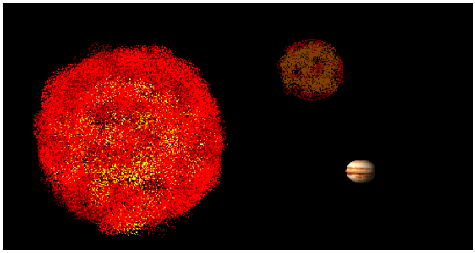

Image Credit: Paul O'Neill, Education Support Officer

Tiny trio A small red dwarf star compared to a brown dwarf and Jupiter.

Image Credit: NASA

Orion the Hunter This constellation contains several giant and super giant stars.

"Brown dwarfs can be thought of as failed stars"

This is called the Hertzsprung-Russell diagram (or HR diagram). It is a very important tool in Astrophysics. You can see that the diagram is divided into several groups. The most important one being the 'main sequence' which runs from the top left to the bottom right. Our Sun is a G type main sequence star. Only about 8% of all stars are G type so our Sun is actually quite exotic. The most common group by far is the M type stars (about 78% of the main sequence stars are M type). Most of these are small red dwarf stars. In contrast O-type stars are very big and very luminous though not always very bright – at least not in visible light; because they are so hot they shine mainly in UV light. Since they are so hot it is believed that planets cannot form around them (the planets would evaporate!). An

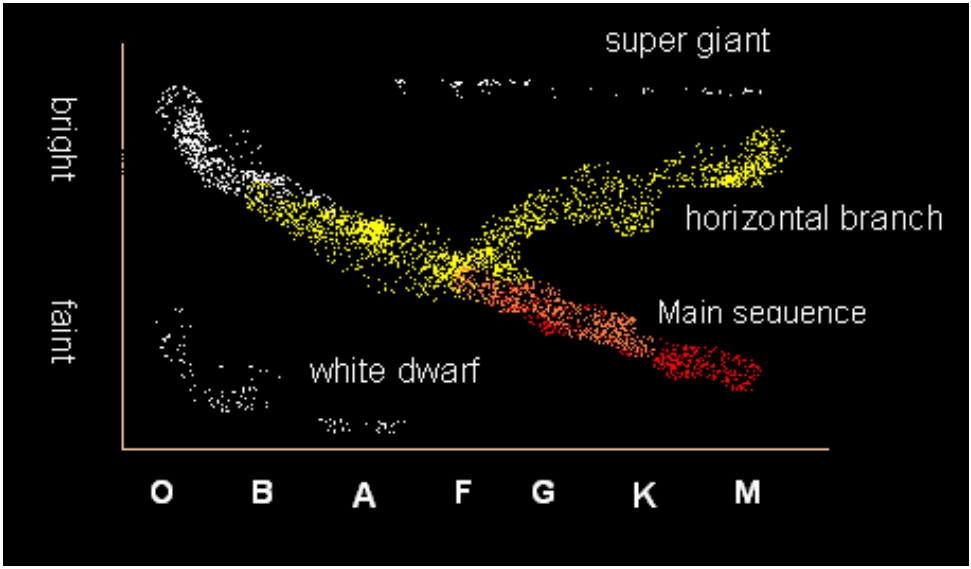

Image Credit: Paul O'Neill, Armagh Planetarium

Hertz-Russell diagram This shows the relationship between star's brightness and surface temperature. It is named for Ejnar Hertzsprung and Henry Norris Russell who independently originated the concept,

easily spotted O-type star is Alnitak, the lowest star in Orion's Belt.

We will take another look at the HR diagram and stellar evolution i.e. what happens to a star from its creation to its death in later Astronotes. I want to finish off this article by taking a look at some of the more exotic spectral types.

W or WR stars: They are also called Wolf-Rayet stars. These have extremely high surface temperatures (up to 70,000 °), eleven or twelve times the surface temperature of the sun. Their spectra have very strong helium lines. It is believed that they are the dying remnants of super giant stars; the outer layer of the star has been blown off into space revealing a hot helium-rich layer beneath.

L and T type stars: at the smaller cooler end of things are the tiny red and brown dwarf stars. Some of them are so small that they are not even classed as proper stars. A star must produce its own light. These objects are either very dim or even black when looked at in visible light. The little they radiate is mainly infra-red light. Brown dwarfs can be thought of as failed stars; much bigger than a planet but just not big enough to make it as a star.

D type stars: These are also dwarf stars but this time white rather than red. They are believed to be the cores of dying stars. All that's left after the outer layers have been blown away. White dwarf stars no longer produce light by nuclear fusion, they continue to glow like a dying ember until they have slowly cooled and become cold black balls of dense matter not much bigger than a planet. Our sun will one day end up as one of these cold dead black dwarfs.