

Bluffer's Guide to Sirius

by Colin Johnston, Science Communicator

Which is the brightest star in the sky? If you can successfully bluff your way in astronomy, you will know to pause and calmly announce the answer to be “the Sun”. Apart from the Sun then? Sirius is the brightest star in the night sky. Many non-astronomers believe that the Pole star (Polaris) is the brightest star. If any of your audience suggest this, gently point out that there are at least forty brighter stars. Polaris wrongly gets the credit, presumably because it is so famous.

Finding Sirius is easy at this time of year. First find the constellation of Orion (you have read last month's Astronotes, haven't you?) Pick out Orion's belt, and follow the line the three stars in the Belt make leftward until you reach a bright star. How far do you need to go? Well, about 20° across the sky. That sounds complicated, but here is a quick tip. If you hold your hand at arm's length, and extend your thumb and little finger, then the distance between the tip of your thumb and the tip of your little finger will be about 20 degrees. If the tip of your little finger is touching the end star in Orion's belt (Alnitak), assuming you are using your right hand with the palm down, then your thumb will be close to Sirius.

Sirius is a member of the constellation Canis Major ('The Big Dog') and is often nicknamed the Dog Star. This comes from the Greek word 'seirios' which means “burning”, presumably it got this name from its blazing brightness. Sirius has been observed over the millennia and it was culturally significant to many ancient civilizations. The ancient Egyptians were particularly fond of Sirius, basing their calendar on when it rose over the horizon. Many websites claim that Sirius got its name from the Egyptian god Osiris, but this is a piece of recently-made-up New Age nonsense.

Sirius is a near neighbour of the Sun, just 8.6 light years (2.6 parsecs) away and is a bluish-white A class star about twice as massive as the

Sun. Its surface temperature is about 9600°C (in comparison our Sun's surface temperature is about 5500°C). Bizarrely, some historical accounts report Sirius as being red, and it is extremely hard to explain how this could have been. Any recent stellar transformation this complete and would have been so drastic it would have left some trace we could observe today. We have to assume that there has been some kind of mistake made. Today Sirius is what proper astronomers call a 'main sequence star', meaning it is happily shining away generating energy from hydrogen. We expect Sirius will stay like this for another billion years or so.

Since the 1840s we have known that Sirius has an unseen companion. By observing the position of Sirius very carefully, astronomers noticed that the star was moving slightly in a predictable manner. It was clear that Sirius was being tugged by the gravitational pull of another object, so there was something else orbiting Sirius, too faint to be seen. However, telescopes were increasing in size and in 1862 the companion was seen for the first time. This odd little star is Sirius B (sometimes Sirius 'proper' is called Sirius A) or the Pup (since its bigger partner is the Dog Star) and is classed as a white dwarf.

White dwarfs are not a clan of bearded mini-Vikings from 'The Lord of the Rings', they are old stars on their very last legs. All the stars we can see with the naked eye are shining because they are 'burning' the gases they are made up of. I say 'burning' rather than burning, because this is a nuclear process, not what goes on in your fireplace. Most stars are mainly hydrogen and deep in the hot pressure cooker of their interiors, hydrogen atoms are fusing together, forming helium atoms and giving out energy as a by product. For all but the largest stars this can go on for billions of years until all the hydrogen is used up and the star is said to be on the main sequence.

When the star's hydrogen fuel is all gone, the

star has no choice but to begin 'burning' helium instead. As it 'burns' helium, the star swells up enormously into a red giant star (red giants are not characters from the works of JRR Tolkien either, Aldebaran in Taurus and Betelgeuse in Orion are examples of red giant stars), it is still shining but the end is in sight. Once the red giant has 'burned' up its helium it basically gives up: with a final despairing wheeze it blasts its outer layers off into space forming a planetary nebula.

“Since the 1840s we have known that Sirius has an unseen companion”

At the centre of the nebula is a very hot speck, the white dwarf, essentially this is the core of the defunct star. The white dwarf will shine on for a very long time but it is to all intents and purposes dead. It is not actually generating energy anymore, just radiating off heat it accumulated while it was alive. This means the white dwarf is gradually cooling and eventually, after a very long time, will end up as a cold, dark cinder which will just sit there doing nothing essentially forever. The best estimates suggest Sirius B has been a white dwarf for about 120 million years.

White dwarfs are very compact objects, usually about half the Sun's mass is squeezed into a volume as big as the Earth. Sirius B is actually unusual as it is about as heavy as the Sun. Squeezing so much stuff into a tiny space means it is very dense, you couldn't use a tea spoon to scoop up a sample of Sirius B, as your spoonful would weigh about five tonnes! Sirius B's surface temperature is about 25 000°C, much hotter than Sirius A or indeed our Sun. Again, that is because it is so small, all the heat is concentrated into a small volume. Sirius B swings around Sirius A in an eccentric orbit. Their separation varies from 8 to 30 AU, so if Sirius B was a member of our solar system, its orbit would take from inside the orbit of Saturn to as far out as Neptune. By the way, for more than a century some astronomers have reported apparent orbital irregularities in Sirius B, suggesting there may be a third very small star in this system, but this has never been confirmed.



Image Credit: NASA

The Sirius System An artist's impression of Sirius (Canis Major A) blazing in the darkness, while Sirius B (Canis Major B) shines less ostentatiously on the right.

You may remember that I said as it uses up the hydrogen in its core in the next billion years or so Sirius A will stay on the main sequence. After that period, it too will inflate up into a red giant until all its helium is gone. Once that happens, Sirius A will persist as a white dwarf, orbited by its fellow white dwarf for aeons to come.

“Frankly Canis Minor is a pathetic constellation”

Apart from Sirius, to be brutally honest there is nothing else really interesting in Canis Major. There are seven more stars, none especially significant and M41, a faint open cluster. You will need a very dark sky to find M41 and afterwards you may not think it was worth the trouble. So what else is worth pointing out in the vicinity of Sirius? About 25° above Sirius (do the trick with your hand I mentioned earlier to gauge the distance) you will find another bright star. This is Procyon, the eighth brightest star in our sky. Procyon means “before the Dog” because to people in the northern hemisphere it rises before Sirius. It is a member of Canis Minor (‘the Little dog’) a frankly pathetic little constellation consisting of Procyon and one other star (Gomeisa). Procyon has some similarities to Sirius - note these are purely coincidental - Procyon is also a near neighbour of the Sun being about 11.4 light years away (3.5 parsecs). Procyon also has a white dwarf companion which orbits it about

as far away as Uranus is from the Sun. However, Procyon is very different from Sirius, being a yellow F class main sequence star about 1.5 times as massive as the Sun and about 7.5 times as bright as the Sun. It seems to be a relatively young star, perhaps only around 1.7 billion years old, but it will not last as long. As it is so bright, Procyon must be using up its stockpile of hydrogen very quickly and will soon enter its red giant phase. In fact, this may be happening at this very moment, as Procyon is unusually bright for a star of its class.

Together with Betelgeuse in Orion, Sirius and Procyon make up an asterism called the Winter Triangle. Why not impress your audience by giving them a tour of the highlights of the winter, leading them from Sirius to Procyon, then to the wonders of Orion and Taurus?

The next article in this series will be coming a

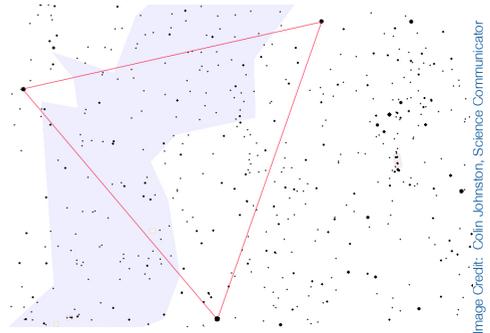


Image Credit: Colin Johnston, Science Communicator

The Winter Triangle Procyon is at the left, Betelgeuse is at the right (much of the rest of Orion can be seen) and Sirius is at the bottom. Image created with Starry Night software.

little closer to home with a guide to Saturn, the real Lord of the Rings.