Tour the sky’s reddest stars

Observers love red stars, and they’re cool in more ways than one. First, they have the lowest surface temperatures of any stars. And second, they’re great fun to look at because not many astronomical objects reveal their colors to the eye. But what makes them so red? And where do you find the reddest? This guide will help you discover some of these under-observed jewels.

Few naked-eye stars show color. The closest we come to seeing a bright red star without optics is coppery Beteigeuze (Alpha Orionis) and orange Antares (Alpha Scorpii). And while some may quibble about the reality of green stars or if a star looks purple due to a contrast effect, nearly everyone sees red well.

How red is red?

Astronomers determine a star’s redness by observation and simple math. They measure the star’s magnitude through blue (B) and visual (V) filters. They then subtract the visual magnitude from the blue. This leaves a number — designated B−V — called the color index. The more positive the color index, the redder the star is. For example, if a star has a blue magnitude of 5 and a visual magnitude of 3, then B−V = 2.0. Color indices range from about −0.5 to the bluest stars to a bit more than 0.0 for the reddest. A color index of 2 makes our example a red star. The Sun’s color index is 0.65.

Other color indices exist. Adding ultraviolet, red, and infrared filters gives rise to U−B (usually for hot objects), R−I (for cool objects), and other combinations. B−V, however, is the color index astronomers use most often.

Jewel in the king’s crown

Mu (μ) Cephei sits 4.9° southeast of magnitude 2.4 Alpha Cephei. In 1783, German-born English astronomer Sir William Herschel (1738–1822) described this star as having “a very fine deep garnet colour, such as the periodical star o...” Later, Italian astronomer Giuseppe Piazzi (1746–1826) called it Garnet Sidus in a catalog of stars he compiled. ‘Today, we know it as Herschel’s Garnet Star.

As the prototype of a class of variable stars called Mup Cephei variables, this star swings between magnitudes 3.6 and 5 during a period of roughly 2 years. These numbers, however, give only its apparent brightness. In reality, Mu ranks as one of the brightest and largest stars known. More than a billion Suns could fit inside Mu Cep, and, if it occupied our solar system’s center, its outer atmosphere would lie beyond Jupiter’s orbit. It outstrips the Sun’s energy output by some 350,000 times. For Mu, B−V = 2.26.

Superb!

In the northern constellation Canes Venatici the Hunting Dogs, only 9° west of the famous Whirlpool Galaxy (M51), sits a variable star labeled Y. Its magnitude ranges from about 4.8 to 6.3 during a 160-day period. Because Y doesn’t strictly adhere to this schedule, astronomers classify it as a semi-regular variable. But what makes it famous is its color.

Italian astronomer Father Angelo Secchi (1818–1879), who classified a large number of stars by their spectral types, was so impressed with Y CVn that he called it “La Superba.” Scientists study a star’s spectrum by measuring the intensity of its light at different wavelengths.

The standard spectral classes assign letter to stars based on their temperatures. From hottest to coolest, the letters run O, B, A, E, G, K, and M. Since that system debuted, however, astronomers have classified even cooler stars. And the coolest of all are carbon stars, designated C.

Carbon stars are giants much larger than the Sun that have evolved past the point where only hydrogen fusion provides their energy. In these stars’ cores, helium fuses into carbon and oxygen at much higher temperatures. Because the energy output has increased, the outer layers of these stars swell and cool, thus becoming red. But a standard red giant doesn’t appear all that red because its production of oxygen is greater than that of carbon.

In carbon stars, however, carbon production outpaces that of oxygen, and carbon compounds such as carbon monoxide (CO) and cyanogen (CN) migrate to the star’s surface. There, carbon molecules absorb short-wavelength light (green, blue, and violet), making the star abnormally red. In the case of La Superba, B−V = 2.55.

A drop of blood

The star R Leporis in Lepus the Hare is another variable carbon star that appears intensely red. With a B−V of 2.7, R Lep rose to notoriety in October 1845, when British astronomer John Russell Hind (1818–1878) discovered it. He found its color, “of the most intense crimson, resembling a blood-drop on the background of the sky, as regards depth of color, no other star visible in these latitudes could be compared with it.” R Leporis now carries the moniker “Hind’s Crimson Star” after its discoverer.

Tips for observing red stars

First, use your largest telescope. Your eyes require a minimum brightness to trigger their color receptors. That’s why we see color during the daytime, but not at night without artificial lighting.

Center the star in your eyepiece’s field of view, and ever-so-slightly defocus the image. Spreading out the star’s light into a small disk will allow you to see its color.
better. Be aware that your scope’s optics may not be perfectly aligned. First, adjust the focus so the eyepiece moves inward. Then, move past the focus point an equal amount in the other direction. View whichever disk looks rounder.

If possible, observe these targets when they’re on or as close to the meridian (the imaginary line passing north to south through the overhead point) as possible. A star on the meridian sits highest in the sky. Viewing any star at other than its maximum altitude introduces false reddening from our atmosphere, like the Sun’s changing color at sunrise and sunset. Believe me, you won’t need the help.

Author picks
Along with the three famous stars above, lots of other deep-red stars populate the sky. Here are some of my favorites:

- V Cygni may be tough to observe at minimum, but its color index of 4 makes the effort worthwhile. During its 420-day period, this star drops 6 magnitudes, from 7.8 to 13.8. Luckily, even at maximum brightness, you’ll see a lot of red. Find this star 2.9° north of Deneb.

- Southern Hemisphere observers should look for DY Crucis, also known as Ruby Crucis — a well-deserved name considering its B–V of 5.56. This star varies in brightness from magnitude 8.6 to 9.8 and lies quite close to Mimosa (Beta Crucis).

- Perhaps the sky’s reddest star is V Hydrae. It sits 3.5° south-southwest of Alkes (Alpha [α] Crateris). At maximum brightness, V Hya hovers near naked-eye visibility at magnitude 6.5, but it drops to magnitude 12 during a 533-day period.

For the best view, move magnitude 1.3 Mimosa out of your eyepiece’s field of view.

- V Hydrae — Observers consider this the reddest of all stars when its brightness lies at minimum, and with a B–V of 5.5, I can’t disagree. V Hydrae’s magnitude varies between 6.5 and 12 during a 533-day period. V Hya sits in central Hydra near its border with Crater the Cup. Observe it in early May when it lies near the meridian an hour after sunset. On star maps, don’t confuse it with Nu (ν) Hydrae, which lies 5° north. The Greek letter Nu looks like a V.

You want more?
The Saguaro Astronomy Club (SAC) of Phoenix maintains a number of great observing databases, one of which contains 333 red stars. Go to www.saguaroastro.org/content/downloads.htm, and click the “SAC red stars database” to download it.

Red stars will please your eyes and help you refine your telescope skills. If you keep an observing log, you may exhaust your thesaurus searching for other ways to say “red.” One thing’s for sure, though. Looking at these stars won’t give you the blues.