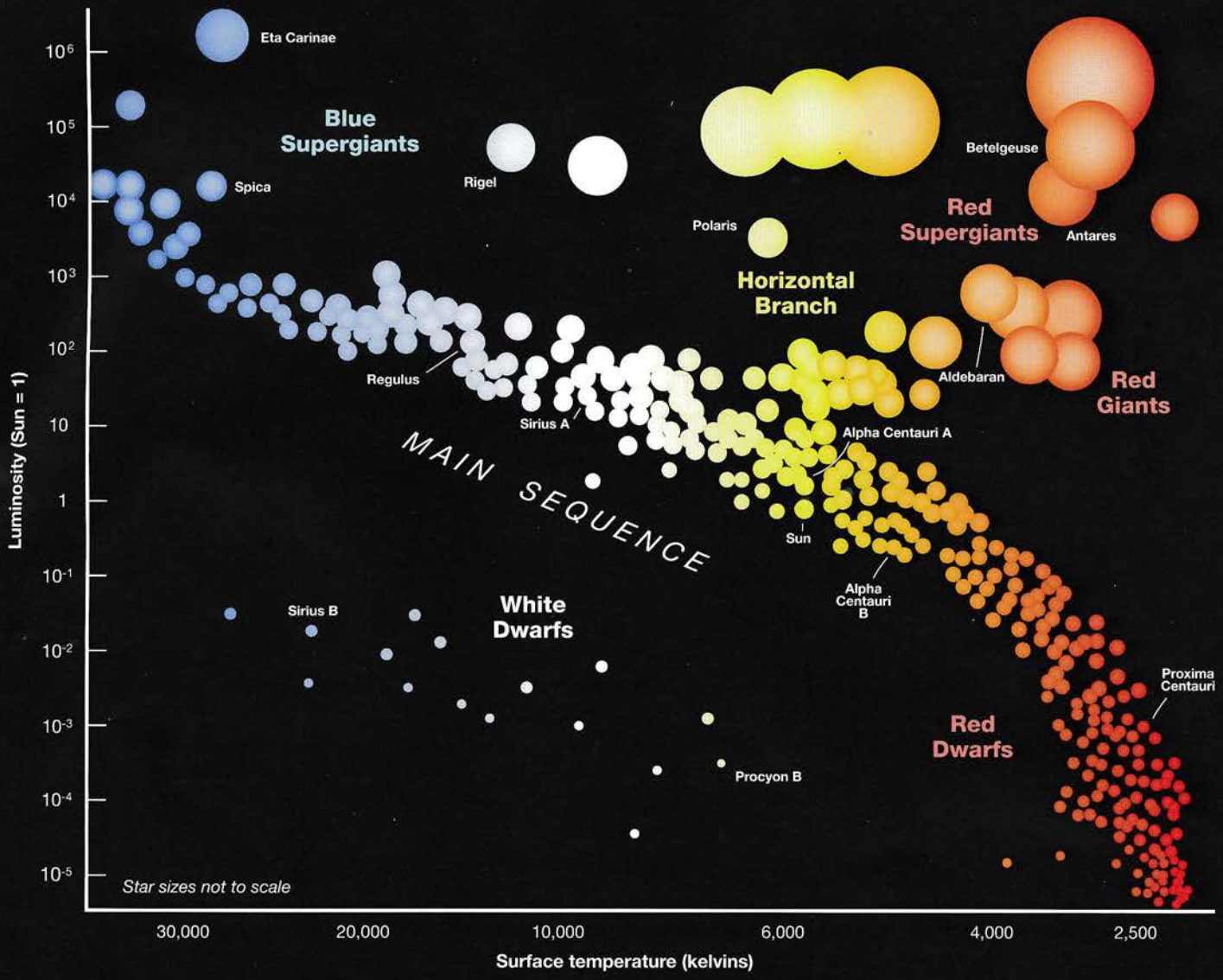

The lives of stars

OUR SUN IS an average star about a third of the way through its lifetime. For most of a star's existence, its colour and brightness depend almost entirely on how much hydrogen it was born with. Stars much more massive than our Sun are hot, bright and blue-tinted; stars less massive than ours are comparatively cooler, fainter and red-hued.

The plot of colour (temperature) versus absolute brightness (luminosity) above, shows that most stars lie along a swath called the *main sequence*. (Our Sun is about midway along this arc.) Main-sequence stars are busy burning hydrogen in their cores. Red giants and supergiants, for their part, have stopped hydrogen core-burning. Instead, they host vast envelopes of gas that surround nuclear shell-burning layers around an inert, compact core.

Plots like that seen here are called Hertzsprung-Russell diagrams after the two astronomers — one Danish and one American — who independently developed them in the early part of the last century. Mainstays of modern astronomy, H-R diagrams have greatly aided astronomers in teasing out the secrets of stellar evolution.

Despite in many cases truly astronomical longevity, all stars must die, and their initial mass largely determines their fate. Late in their lives, stars that end up with cores of about 1.4 times the mass of our Sun or less will, after using up the last of their fuel, become white dwarfs. That's our own star's destiny, far off in the future. By then it will have shrunk to not much larger than the Earth, but it will bear an incredible density: One teaspoon of its matter would weigh about a metric ton.

Those stars whose late-life cores have between roughly 1.4 and 3 times the Sun's mass will, at some sudden moment, cataclysmically explode in a supernova and wind up as neutron stars. The size and density of these objects make white dwarfs seem huge and practically porous in comparison: A teaspoon of neutron star, which is only 10 or 20 kilometres across, would weigh a *billion* tonnes.

Finally, those stars with cores over 3 times our star's mass will, after going supernova, condense into black holes.

LEAH TISCIONE / S&T