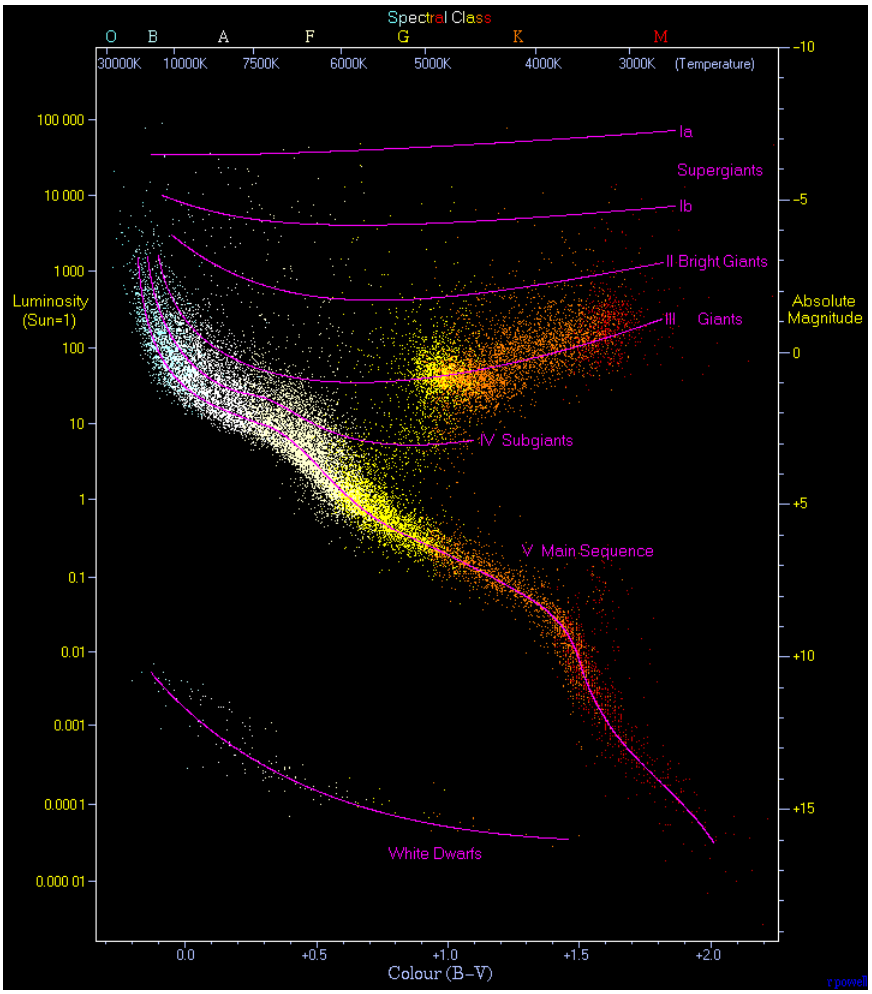
11.2: Hertzsprung- Russell Diagram

Hertzsprung- Russell Diagram

The **Hertzsprung- Russell diagram** , or the **H-R diagram** , is a graph which plots a star's brightness versus its color. This very-useful graphic was developed around 1910 by Danish astronomer **Ejnar Hertzsprung** and American astronomer **Henry Norris Russell** . The H-R diagram groups stars into four major classes, and shows stellar evolution: how stars change as they fuse the elements in their stellar cores.

The H-R diagram itself will appear different than most graphs. Yet, with one glance, you can see stellar groupings, brightness, and colors. The stellar colors are reflective of the star's photosphere, or surface temperature. The hotter the star, the more bluish it will appear. And, the cooler the star, the more reddish in color.



Hertzsprung-Russell diagram, or H-R diagram. Some 22,000 stars make up the data for this specific illustration. HRDiagram by Richard Powell is licensed under CC BY-SA 2.5

Let's first examine closely the above H-R diagram illustration.

The Y-axis plots the star's brightness. This particular illustration uses a familiar unit: the Sun. So, with the Sun = 1, stars are plotted when compared to the Sun. This is their absolute magnitude or brightness, not how they look in the sky, or apparent magnitude. (A topic discussed in Lab 3. *Magnitude and Light Pollution*). For those so inclined, the Y-axis is plotted on a logarithm scale. The Y-axis can also be plotted in absolute magnitude. Most plots are based on the Sun = 1, though.

If you also note on the right-hand side of the graph along the Y-axis, you will see numbers and Absolute Magnitude. This is the other way to represent stellar brightness's.

The X-axis plots the star's temperature. Look at the values of the X-axis along the top of the illustration (not the bottom – more on that later). You will note at the very top a line of letters; O B A F G K M. Right below that you will also note numbers; 30000K 10000K 7500K 6000K 5000K 4000K 3000K. These numbers will be our primary focus: they are the star's photosphere temperature in the Kelvin temperature scale. You are familiar with the Fahrenheit and most likely the Celsius or Centigrade temperature scales. The Kelvin temperature scale is like the Celsius temperature scale, but starts at zero, called absolute zero. There are no negative temperatures on the Kelvin temperature scale; it always starts at zero. Astronomers prefer the Kelvin temperature scale because there are referrals to the coldest temperature in space — which is just above 0K or absolute zero.

Some astronomers prefer to use what is known as the Color Index — Colour (B-V) — found along the bottom X-axis on the illustration. This is another way to classify a star's temperature and color.
