Dowling College ESC 1022

Student name: ____________________________________

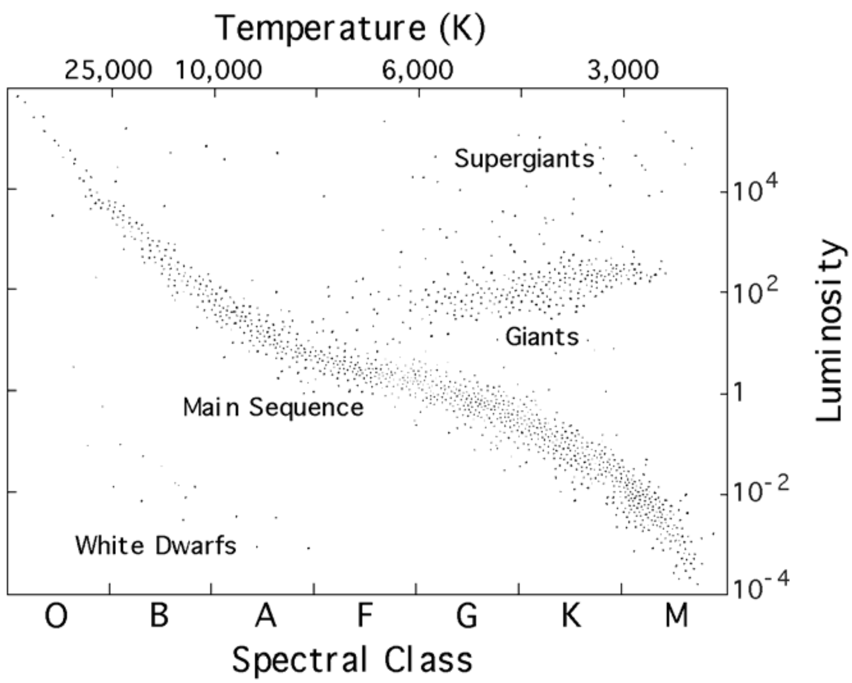
Hertzsprung - Russell diagram

Stars can be classified in many ways. We have already seen that the magnitude scale is used for rating stars according to how bright they appear in our night sky. Many people erroneously refer to a bright star in the sky as being "big." How often have you heard, or perhaps even said, "Wow, look at that big star there," when you were really pointing to a very bright star? A star's apparent brightness in our sky tells us very little about its true nature. For instance, it may shine brightly in our sky because it actually *is* very large, or it may be that the star is quite close to us. Certainly, the Sun is the brightest star in our sky, but we know that is only because it is so nearby. Intrinsically, the Sun is actually rather dim as stars go.

To get a feel for the true nature of stars, we must study other aspects, such as their luminosity and surface temperature. Luminosity, sometimes referred to as "absolute magnitude" in other texts, is a measure of how bright a star *really* is, while its temperature is a measure of the temperature of its visible surface. Using the Sun as an example, when we talk about its surface temperature, we are referring to the temperature of the photosphere. Both surface temperature and luminosity, as well as other attributes such as composition, can be measured by passing a star's light through a prism-like instrument, called a *spectrometer*, attached to a telescope.

In about 1910, having investigated the effect of the temperature of an object and the color of radiation given off, several scientists reasoned that it should also be possible to relate the temperature of a star to its luminosity. If all stars were alike, stars of the same temperature would give off the same amount of light. Hotter stars would be brighter than cooler stars. The first diagram (luminosities vs. surface temperatures [color] of stars) was plotted by Ejnar Hertzsprung in 1911, and (independently) by Henry Norris Russell in 1913. This diagram came to be known as the Hertzsprung Russell diagram, or simply the HR diagram.

The HR Diagram is a "two-dimensional" plot of stars, and represents one of the greatest observational syntheses in astronomy and astrophysics! The horizontal scale (X-axis) shows the temperature of the stars. It is by convention reversed so that the hottest stars are located near the origin, and the coolest stars are to the right. The vertical scale (Y-axis) plots the stars' luminosity with respect to the Sun's light output. Therefore, the Sun is set at "1", and other stars would be ranked accordingly.



Procedure

In this exercise, you will construct two separate H-R diagrams. Begin by labeling the first diagram “H-R Diagram 1" and plot on it the locations for all of the nearest stars to the Sun listed in Appendix 10 based on their spectral type and luminosity values in the table. On the second H-R Diagram (which you should label "H-R Diagram 2"), plot the locations of all of the brightest stars in the sky (as listed in Appendix 11), again based each star's luminosity and spectral type.

Once both diagrams are complete, answer the following questions based on the diagrams you have created.

Questions:

1. What class of star is located to the lower left on an H-R diagram? Upper right?

2. Where are the hottest stars plotted on an H-R diagram? The highest luminosity?

3. The stars in the upper right of the diagram are very bright but are also very cool. If the stars are cool, why do you think they are so bright?

4. How many of the stars listed in Appendix 10 are found along the Main Sequence?

5. How many stars listed in Appendix 10 are more luminous than the Sun? How many are less luminous?

6. How many of the stars listed in Appendix 11 are found along the Main Sequence?

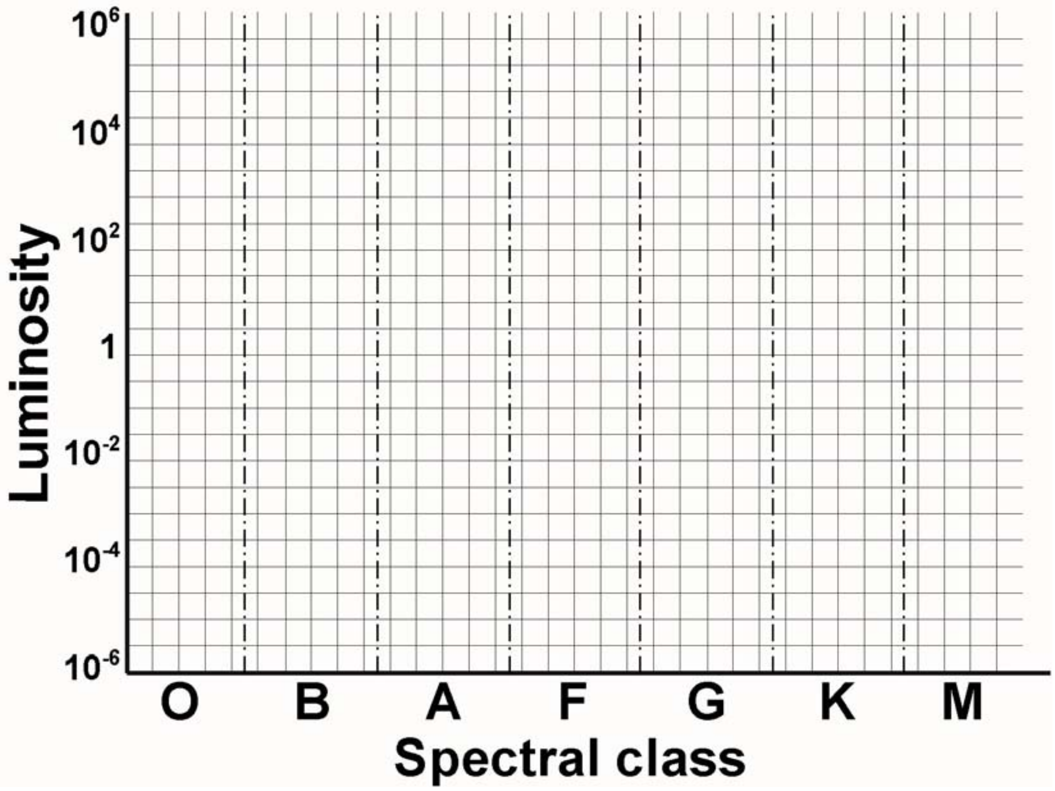
7. How many stars listed in Appendix 11 are more luminous than the Sun? How many are less luminous?

8. Since an object appears brighter if it is closer to you than it does if it is far away, one might expect the closest stars to also appear as the brightest stars. Is this the case? Why do some distant stars appear brighter than some nearby stars?

9. Describe the characteristics of the closest stars: how do they compare with the sun in terms of mass, temperature, radius, luminosity etc. Do the same for the brightest stars.

10. From these observations, what kinds of stars are most common in the Galaxy? What kinds are rare? From what you know of stellar evolution, why should this be expected?

H-R Diagram # ________



H-R Diagram # ________