

Properties of Stars

Name: _____

The Hertzsprung-Russell diagram, or H-R diagram, is a graph in which a star's temperature is plotted against its absolute magnitude. From such a diagram, other information about a star's properties and life cycle can be determined. In this lab, you will construct an H-R diagram using data on the 20 stars that are nearest to our sun (Figure 21.1) and the 20 stars that appear brightest in our sky (Figure 21.2).

In the tables in Figures 21.1 and 21.2, the unit used for distance is the parsec. A **parsec** is equal to 3.26 light-years (ly). The Kelvin (K), or absolute temperature scale, is used in the tables and in the diagram (Figure 21.3).

Procedure:

1. Study the lists in Figures 21.1 and 21.2 and answer the Analysis and Conclusion questions **1 AND 2 (ONLY)**.

*** In procedure steps 2 and 3, you will graph the stars onto the H-R diagram. The following tips may be useful:

- Temperature is on the horizontal axis, absolute magnitude is on the vertical axis.
- Notice that the graph lines used to plot temperature are unevenly spaced, and that the number of Kelvins between each line is not constant. Carefully check a star's temperature and the value of a particular line before plotting each star.
- Absolute magnitude decreases as you move up on the H-R diagram.

2. Using a colored pencil of your choosing (preferably RED), graph each of the **NEAREST STARS** (listed in figure 21.1) on the H-R diagram (fig. 21.3).

3. Using a colored pencil of your choosing (preferably BLUE), graph each of the **BRIGHTEST STARS** as seen from Earth (listed in figure 21.2) on the H-R Diagram.

*** STARS IN BOTH CATEGORIES (NEAREST AND BRIGHTEST) SHOULD HAVE A RED DOT WITH A BLUE CIRCLE AROUND IT (OR WHATEVER COLORS YOU CHOSE IN STEPS 2 & 3). ***

4. Answer Analysis and Conclusion questions 3-10.

Analysis and Conclusion Questions

1. Compare the 2 star lists, 20 nearest and 20 brightest. How many stars appear on both the lists? Name them and circle them on the lists.

2. What does your answer to question 1 indicate about the nearest stars? Are the nearest stars also the brightest stars as seen from Earth?

Complete steps 2-4 now.

Fig. 21.1 The 20 Nearest Stars

| Name | Distance (Parsecs) | Temperature (K) | Absolute Magnitude |
|-----------------|--------------------|-----------------|--------------------|
| Alpha Centauri | 1.31 | 5800 | +4.4 |
| Barnard's Star | 1.83 | 2800 | +13.2 |
| Wolf 359 | 2.35 | 2700 | +16.8 |
| Lalande 21185 | 2.48 | 3200 | +10.5 |
| Sirius | 2.67 | 10 400 | +1.4 |
| Luyten 726-8 | 2.67 | 2700 | +15.4 |
| Ross 154 | 2.94 | 2800 | +13.3 |
| Ross 248 | 3.16 | 2700 | +14.7 |
| Epsilon Eridani | 3.30 | 4500 | + 6.1 |
| Ross 128 | 3.37 | 2800 | +13.5 |
| Luyten 789-6 | 3.37 | 2700 | +14.9 |
| 61 Cygni | 3.40 | 2800 | +7.5 |
| Procyon | 3.47 | 6800 | +2.7 |
| Epsilon Indi | 3.51 | 4200 | +7.0 |
| Sigma 2398 | 3.60 | 3000 | +11.1 |
| BD +43°44 | 3.60 | 3200 | +10.3 |
| Tau Ceti | 3.64 | 5200 | +5.7 |
| CD -36°15693 | 3.66 | 3100 | +9.6 |
| BD +5°1668 | 3.76 | 3000 | +11.9 |
| CD -39°14192 | 3.92 | 3500 | +8.7 |

Fig. 21.2 The 20 Brightest Stars as Seen from Earth

| Name | Distance (Parsecs) | Temperature (K) | Absolute Magnitude |
|----------------|--------------------|-----------------|--------------------|
| Sirius | 2.7 | 10,400 | +1.4 |
| Canopus | 30.0 | 7400 | -3.1 |
| Alpha Centauri | 1.3 | 5800 | +4.4 |
| Arcturus | 11.0 | 4500 | -0.3 |
| Vega | 8.0 | 10 700 | +0.5 |
| Capella | 14.0 | 5900 | -0.7 |
| Rigel | 250.0 | 11 800 | -6.8 |
| Procyon | 3.5 | 6800 | +2.7 |
| Betelgeuse | 150.0 | 3200 | -5.5 |
| Achernar | 20.0 | 14 000 | -1.0 |
| Beta Centauri | 90.0 | 21 000 | -4.1 |
| Altair | 5.1 | 8000 | +2.2 |
| Alpha Crucis | 120.0 | 21 000 | -4.0 |
| Aldebaran | 16.0 | 4200 | -0.2 |
| Spica | 80.0 | 21 000 | -3.6 |
| Antares | 120.0 | 3400 | -4.5 |
| Pollux | 12.0 | 4900 | +0.8 |
| Fomalhaut | 7.0 | 9500 | +2.0 |
| Deneb | 430.0 | 9900 | -6.9 |
| Beta Crucis | 150.0 | 22 000 | -4.6 |

- A star located in the lower right portion of the H-R diagram is cool and dim. What are the characteristics of a star in the upper left of the diagram? In the upper right?

- To which group do most of the stars on your diagram belong?

- According to your diagram, are any of the 20 nearest or 20 brightest stars white dwarf stars? What is the evidence of your answer?

- Our sun has a temperature of 6000 K and an absolute magnitude of +4.7. Use an asterisk (*) to show the location of the sun on the diagram. To what group does the sun belong?

- Compare the absolute magnitude and temperature of the sun with those of the other stars in its group.

- Betelgeuse is 150 parsecs away and has a surface temperature of only 3200K, yet Betelgeuse is one of the brightest stars as seen from earth. What does this indicate about the size of Betelgeuse? Is your answer supported by the location of Betelgeuse on the diagram?

- On your H-R diagram, there is another star that is plotted near Betelgeuse. What is the name of the star? What kind of stars it is?

- Compare our sun with the red super giant Antares. Which star is further along in its life cycle? How do you know?
