

Star Life Cycle and the H-R Diagram

How can we use an H-R diagram to know where a star is in its life cycle?

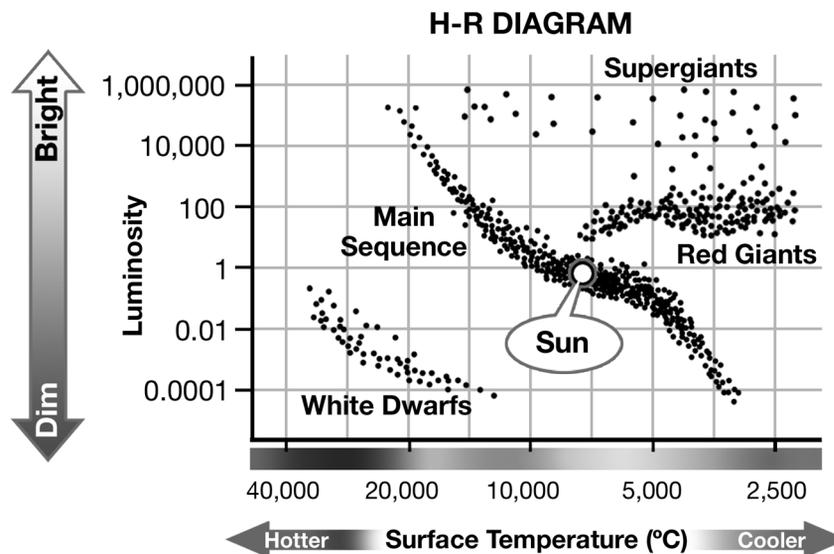
Just like humans, stars go through a life cycle. Over the course of their lives, stars change in ways that make each stage different and recognizable. A useful way to organize this information is in a Hertzsprung-Russell diagram, also called an H-R diagram. In this investigation, you will learn how to identify stars of different types and ages using the information in an H-R diagram.

Materials

- None required

1 The H-R diagram

For astronomers, a graph that displays a star's luminosity on the y-axis and its surface temperature on the x-axis sets up an extremely useful diagram called a Hertzsprung-Russell, or H-R diagram. In 1910 Ejnar Hertzsprung and Henry Norris Russell discovered that when all of the known stars were put on their graph, several obvious groups became apparent. By examining the differences in these groups, later astronomers were able to realize that the groups were best described as stars in different periods in their life cycle, rather than completely different types of stars. Just as infants, adolescents and adults are in different stages of the human life cycle, main sequence, red giants, supergiants, and white dwarfs are stars in different stages of the life cycle of stars.



2 Making observations

- a. Describe the qualities and the location of white dwarf stars based on the H-R diagram.

- b. Describe the qualities and the location of supergiant stars based on the H-R diagram.

- c. Describe the qualities and the location of main sequence stars based on the H-R diagram.

- d. Describe the qualities and the location of red giant stars based on the H-R diagram.

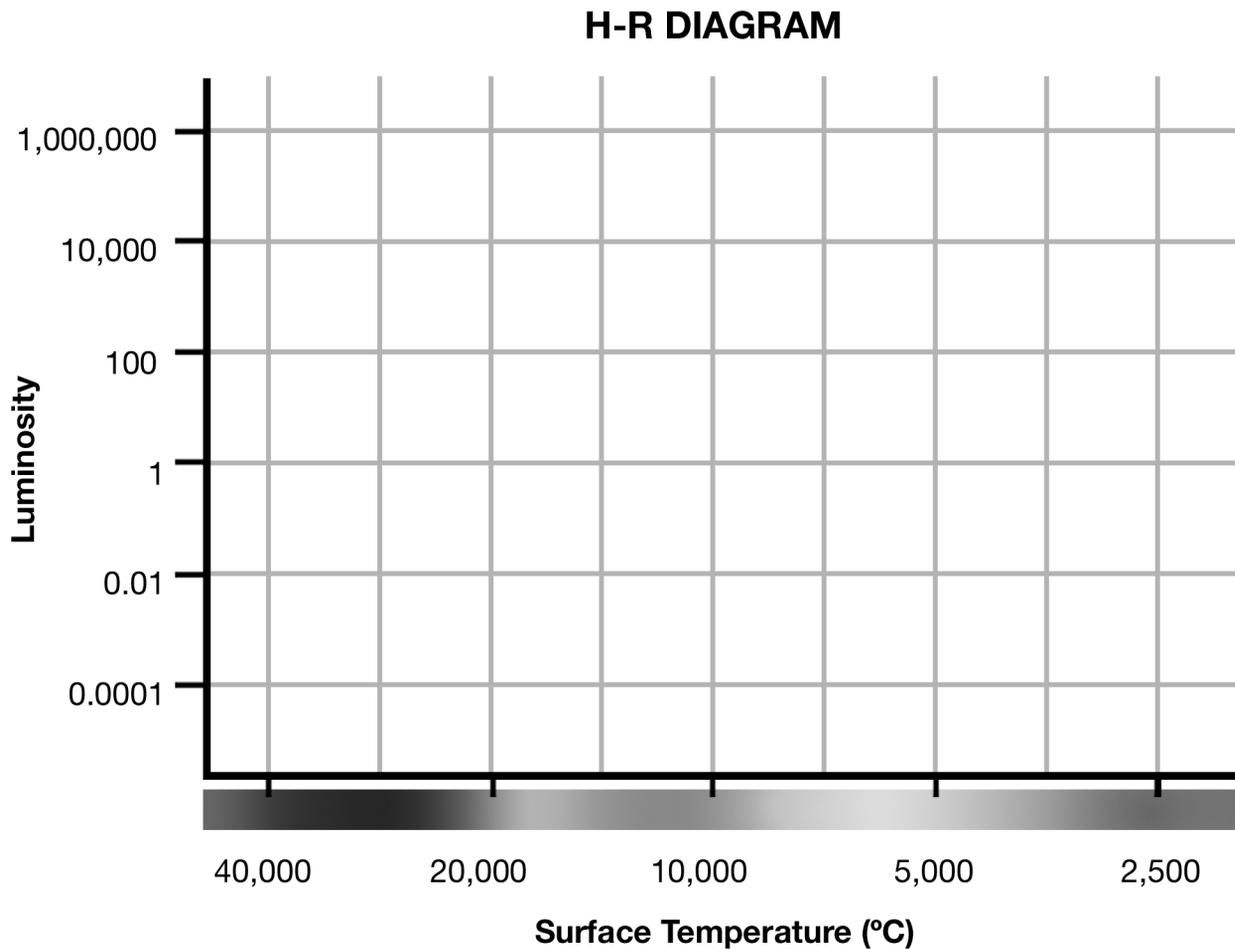
3 Graphing star data

Table 1 contains data concerning the luminosity and surface temperature of 12 stars. Plot each star's data on the grid and label each star (A–L) on Table 2.

Table 1: Luminosity and surface temperature data

	Name	Luminosity	Surface temperature (°C)
A	Proxima Centauri	0.0017	3,100
B	Rigel	66,000	11,000
C	Sirius A	25.4	9,500
D	Sirius B	0.026	25,000
E	Aldebaran	350	3,600
F	Antares	65,000	3,200
G	Arcturus	250	4,700
H	Betelgeuse	135,000	3,300
I	Procyon A	8	6,200
J	Procyon B	0.0005	7,500
K	Pi Andromedae A	800	16,000
L	40 Eridani B	0.013	12,000

Table 2: Star data graph



4 Examining your graph

Compare your graph of star data to the H-R diagram from part 1. Look for groupings on your graph that are similar to the H-R diagram and answer the following questions.

- a. Which stars on your graph are located in the area associated with main sequence stars?

- b. Which stars on your graph are located in the area associated with supergiant stars?

- c. Which stars on your graph are located in the area associated with red giant stars?

- d. Which stars on your graph are located in the area associated with white dwarf stars?

- e. Can you identify which group a star will fit into just by looking at its temperature alone? Its luminosity alone? Explain your answer.

5 Groupings on the H-R diagram and the life cycle of stars

Even though a star is not alive, it goes through a “life cycle” similar to living things. The groups that appear in different sections of the H-R diagram are in different phases of their life cycle.

- a. In what part of their life cycle are main sequence stars; beginning, middle, or end, or some combination of those stages?

- b. What characteristics are common to main sequence stars?

- c. How are red giant and supergiant stars similar? How are they different? Include how each one fits into the life cycle in some part your answer.

- d. In what part of their life cycle are white dwarf stars; beginning, middle, or end, or some combination of those stages?

- e. What characteristics make white dwarf stars different from main sequence stars?

- f. What is the difference between a white dwarf star and a red giant star?

- g. Where is the Sun located on the H-R diagram and what group is it in?

- h. Where would a Black Hole be located on an H-R diagram?

- i. How does a star's location change on an H-R Diagram throughout its life?
