

The Life Cycle of Stars

BEFORE YOU READ

After you read this section, you should be able to answer these questions:

- How do stars change over time?
- What is an H-R diagram?
- What may a star become after a supernova?

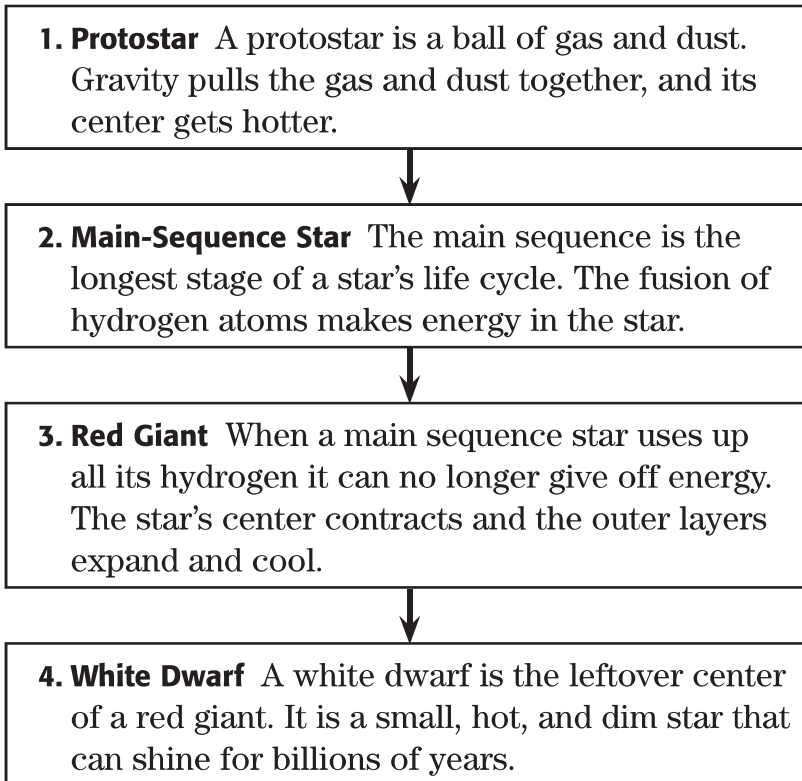


California Science Standards

8.4.b

How Do Stars Age?

Stars do not remain the same forever. Like living things, stars go through a life cycle from birth to death. The actual life cycle of a star depends on its size. An average star, such as the sun, goes through the stages shown below.



STUDY TIP

Organize Make a chart describing the life cycles of average stars and massive stars.

Critical Thinking

1. Analyze Concepts

Scientists can't watch a star through its entire life. A star can live for billions of years! How do you think scientists figure out the life cycle of a star?



TAKE A LOOK

2. Identify This star is in the last stage of its life cycle. What is that stage?

SECTION 2 The Life Cycle of Stars *continued*

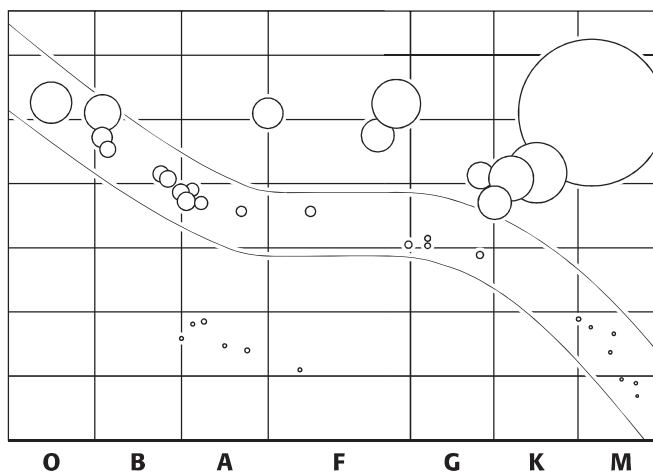
What Is an H-R Diagram?

An **H-R diagram** is a graph that shows the relationship between a star's temperature and brightness. The H-R diagram also shows how stars change over time. The graph is named after Ejnar Hertzsprung and Henry Norris Russell, the scientists who made it. ✓

READING CHECK

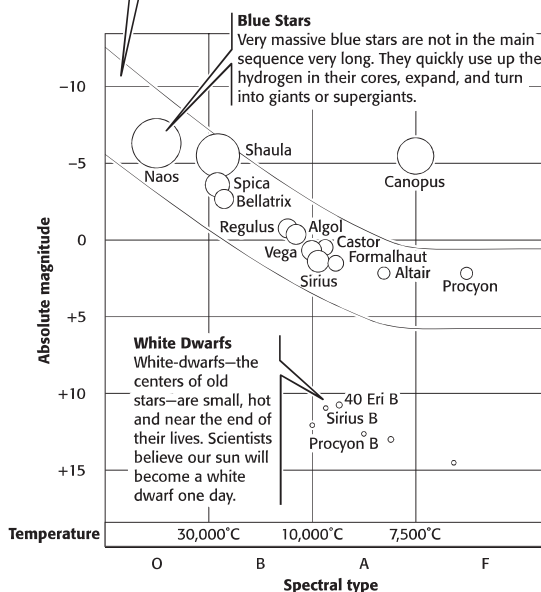
3. Identify To make an H-R diagram, which two characteristics of a star must a scientist measure?

Temperature is given along the bottom of the diagram. Hotter stars are on the left, and the cooler stars are on the right. Brightness, or absolute magnitude, is given along the left side of the diagram. Bright stars are near the top, and dim stars are near the bottom.



Main-sequence Stars

Stars on the main sequence form a band that runs across the H-R diagram. The sun is a main-sequence star. The sun has been shining for about 5 billion years. Scientists think that the sun is in the middle of its life and will remain on the main sequence for another 5 billion years.



TAKE A LOOK

4. Identify Where in the H-R diagram are the brightest stars located?

5. Identify Where in the diagram are the hottest stars located?

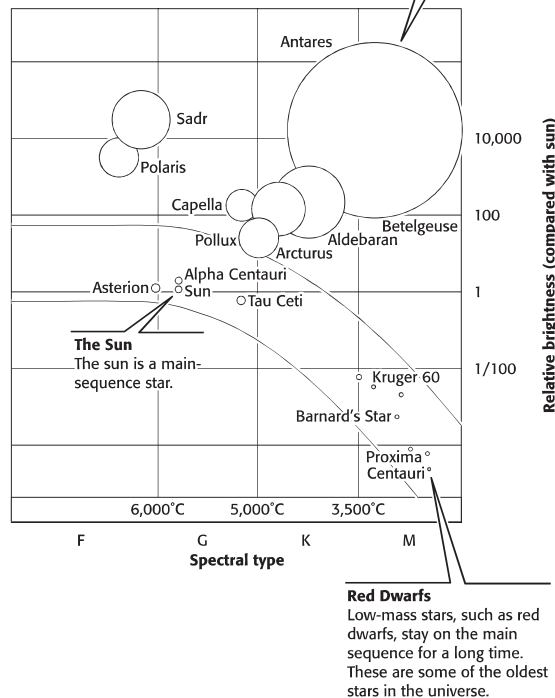
An H-R diagram can show the life cycle of a star.

SECTION 2 The Life Cycle of Stars *continued*

Why Does a Star's Position on the H-R Diagram Change?

The bright line on the H-R diagram is called the **main sequence**. A star spends most of its life on the main sequence. As a main-sequence star ages, it becomes a red giant. When this happens, the star moves to a new place on the H-R diagram. The star's position on the diagram will change again when it becomes a white dwarf. These changes are made because the brightness and temperature of a star change throughout its life. ✓

Continuation of the H-R Diagram



✓ **READING CHECK**

6. Explain Why does a star's position on the H-R diagram change at different stages of its life cycle?

TAKE A LOOK

7. Compare Which star is hotter—Antares or Polaris?

8. Explain Is Betelgeuse on the main sequence?

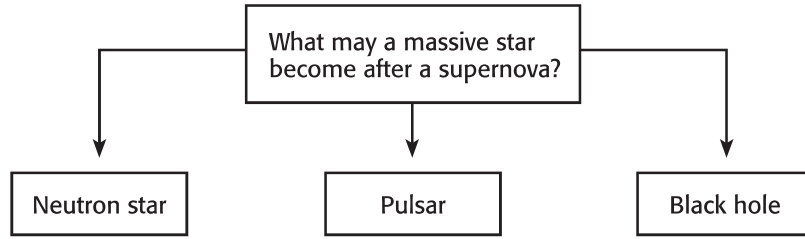
What Happens to Massive Stars as They Age?

Massive stars use up their hydrogen much more quickly than smaller stars. As a result, massive stars give off much more energy and are very hot. However, they do not live as long as other stars. Toward the end of its main sequence, a massive star collapses in a gigantic explosion called a **supernova**. After such an explosion, a massive star may become a neutron star, a pulsar, or a black hole. ✓

✓ **READING CHECK**

9. Identify What can cause a main-sequence star to turn into a neutron star, a pulsar, or a black hole?

SECTION 2 The Life Cycle of Stars *continued*



Critical Thinking

10. Explain Could an average star, such as our sun, become a neutron star? Explain your answer.

NEUTRON STARS

After a supernova, the center of a collapsed star may contract into a tiny ball of neutrons. This ball, called a *neutron star*, is extremely dense. On Earth, a single teaspoon of matter from a neutron star would weigh 100 million metric tons!

PULSARS

If a neutron star is spinning, it is called a *pulsar*. Pulsars send out beams of radiation that sweep through space. A radio telescope, an instrument that can pick up radiation with long wavelengths, can detect a pulsar. Every time a pulsar’s beam sweeps by Earth, scientists hear rapid clicks, or pulses, in the radio telescope.

BLACK HOLES

If the collapsed star is extremely massive, the force of its gravity may cause it to contract even more. This contraction crushes the dense center of the star, creating a *black hole*. Even though they are called holes, black holes aren’t really empty spaces. A black hole is an object so dense that even light cannot escape its gravity.

Because black holes do not give off light, it can be hard for scientists to locate them. Gas and dust from a nearby star may fall into the black hole and give off X rays. When scientists find these X rays, they can infer that a black hole is close by.



Say It

Discuss In small groups, talk about other places you have heard about X rays. Where were they used, and what were they used for?

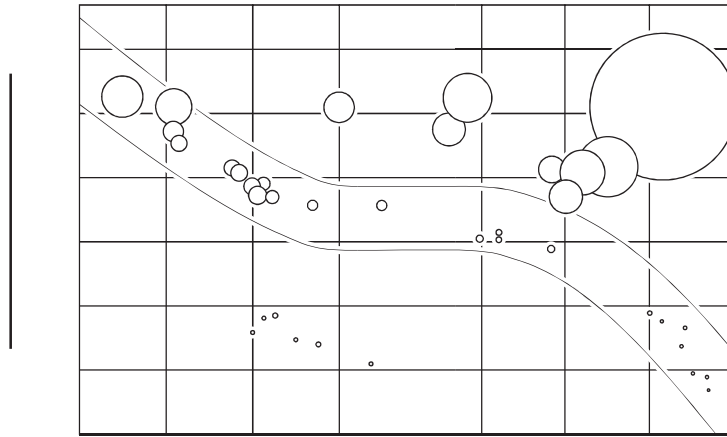
Section 2 Review

SECTION VOCABULARY

<p>H-R diagram Hertzsprung-Russell diagram, a graph that shows the relationship between a star's surface temperature and absolute magnitude</p>	<p>main sequence the location on the H-R diagram where most stars lie; it has a diagonal pattern from the lower right (low temperature and luminosity) to the upper left (high temperature and luminosity)</p> <p>supernova a gigantic explosion in which a massive star collapses and throws its outer layers into space</p>
--	---

1. List What are the stages in the life cycle of an average star?

2. Label Label the axes on this H-R diagram.



3. Explain How does a star's temperature change as the star ages from a main sequence star to a red giant and from a red giant to a white dwarf?

4. Compare How does the life cycle of a massive star differ from the life cycle of an average star?
