18.3 The Sun

Can you imagine life without the Sun? The Sun is the source of energy that sustains all life on Earth. What is the Sun? Why does it produce so much energy? Read on to find the answers to these questions, and many more.

The Sun is a star

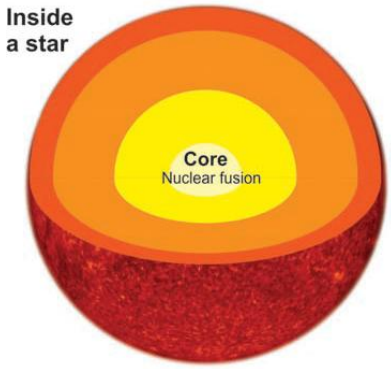
The Sun is a star The Sun is a star (Figure 18.19). A **star** is a giant, hot ball of gas held together by gravity. Gravity squeezes the atoms in the core of a star so tightly that they fuse together in a reaction called *nuclear fusion* (Figure 18.20). In the process, huge amounts of energy are given off. That's why stars like the Sun give off light and heat. The Sun is one of at least 200 billion stars in our galaxy.

A medium-sized star

The Sun is medium-sized compared with other stars in the universe. Its diameter is about 1.4 million kilometers, or about 109 times the diameter of Earth. Approximately 1 million planet Earths could fit inside the Sun! By contrast, one of the star "supergiants" called Betelgeuse sometimes reaches a diameter that is almost 600 times that of the Sun. If the Sun grew to the size of Betelgeuse, it would swallow up Mercury, Venus, Earth, and Mars!

What is the Sun Made of?

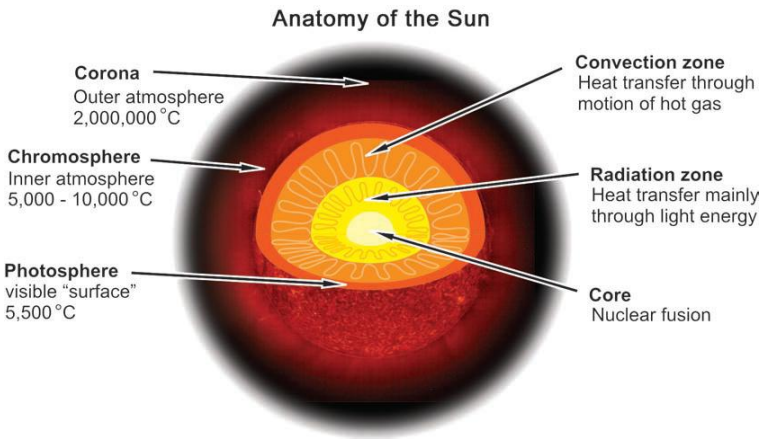
The Sun is about 75 percent hydrogen and 25 percent helium, with very small traces of other elements. Unlike Earth, the Sun does not have a solid surface—instead; it is made completely of gas. Because of its size, the Sun contains 99.8 percent of the mass of the solar system. Because of its mass, the Sun's gravitational force is strong enough to hold the entire solar system—including the planets, dwarf planets, asteroids, and comets—in orbit.



Anatomy of the Sun

The Sun has three regions

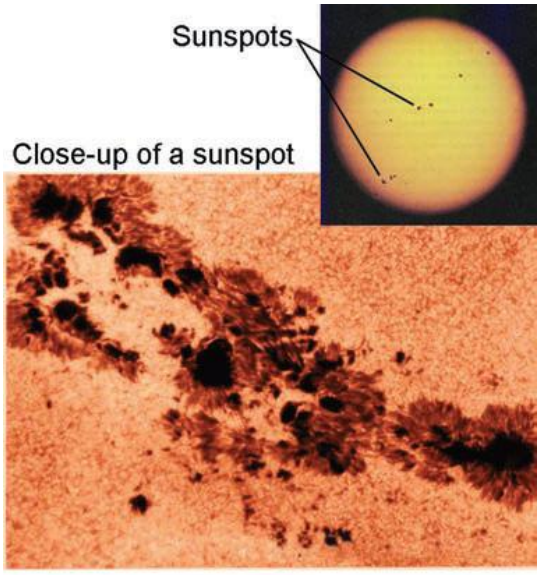
The apparent surface of the Sun that we can see from a distance is called the *photosphere,* which means "sphere of light." Just above it is the *chromosphere.* This is a very hot layer of plasma, a high energy state of matter. The *corona* is the outermost layer of the Sun's atmosphere, extending millions of kilometers outward.



Sunspots

A safe method for viewing the Sun is to use a telescope to project the Sun's image onto a white surface (Remember, you should NEVER look directly at the Sun). When the Sun is observed in this way, small, dark areas can be seen on its surface. These areas, called *sunspots*, may look small, but they can be as large as Earth. **Sunspots** are areas of gas that are cooler than the gases around them. Because they don't give off as much light as the hotter areas, they appear as dark spots on the photosphere (Figure 18.21).

Figure 18.21: *Sunspots appear as dark spots on the photosphere.*



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Features of the Sun

Prominences and solar flares

Sunspots are linked to other features of the Sun. Occasionally, large "loops" of gas called *prominences* can be seen jumping up from groups of sunspots. These can be observed during eclipses and appear as loops that extend beyond the chromosphere. Sometimes prominences from different sunspot regions suddenly connect, releasing very large amounts of heat and light known as *solar flares* (Figure 18.22).

Solar wind

The Sun gives off more than just heat and light. It also gives off something called solar wind. *Solar wind* is an electrically charged mixture of protons and electrons. Evidence of solar wind comes from the tails of comets, which always face away from the Sun. A comet's tail acts like a "wind sock" and shows that there is a continuous flow of particles coming from the Sun.

Magnetic storms

Solar flares can greatly increase the amount of solar wind given off by the Sun. These solar wind particles can affect Earth's upper atmosphere, causing *magnetic storms*. Magnetic storms can disrupt radio and television signals, interfere with telephone and cell phone signals, and even cause electrical power problems for homes and businesses.

Auroras

Solar winds sometimes cause a mysterious phenomenon known as an **aurora** to occur. Auroras (known in the Northern hemisphere as the northern lights) occur when the protective layers of our atmosphere are energized by solar winds. This energy causes atoms and molecules in the upper atmosphere to give off light. The most common color produced is a yellow-green caused by oxygen atoms at an altitude of about 60 miles. These lights appear as curtains above the horizon (Figure 18.23

Figure 18.22: *Solar flares release large amounts of heat and light.*

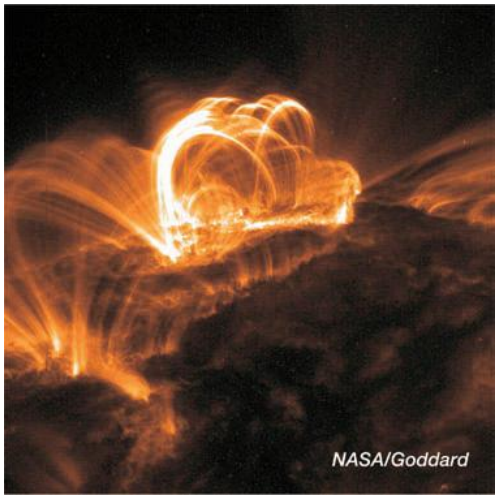


Figure 18.23: *Solar winds can cause auroras to occur.*

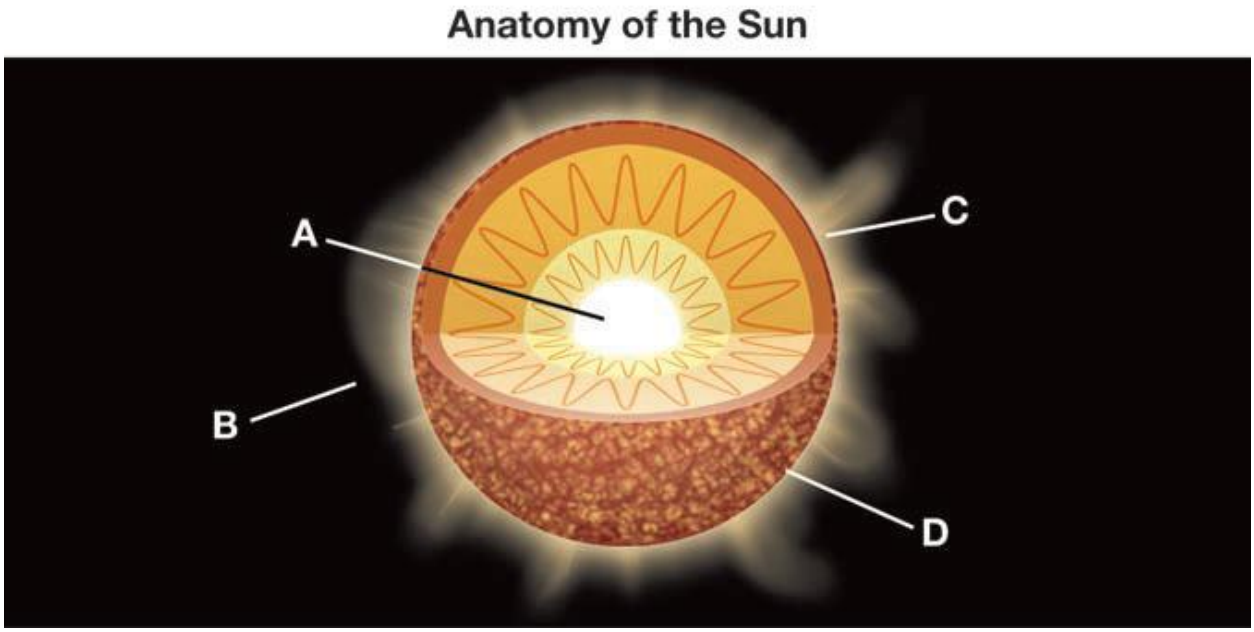
18.3 Section Review

1. What is a star? How is a star different from a planet or a moon?

2. Why does the Sun give off heat and light?

3. The Sun is made mostly from which of the following elements?
a. gold
b. lead
c. hydrogen
d. nitrogen

4. On the diagram below, label the following: photosphere, chromosphere, core, corona.



5. Explain the meaning of the following terms:
a. sunspot

b. magnetic storm

c. solar flare

d. solar wind

e. aurora