The Sun

A Reading A–Z Level V Leveled Book
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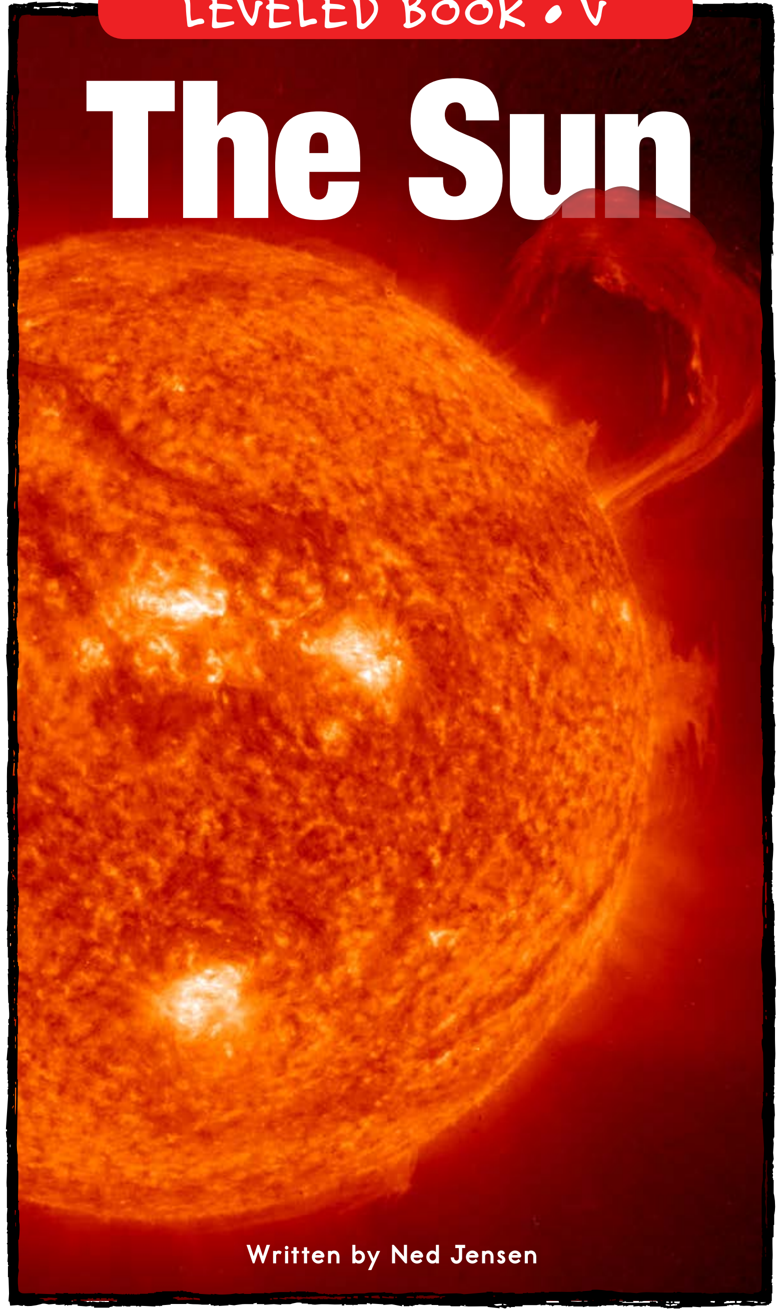
LEVELED BOOK • V

The Sun



Written by Ned Jensen

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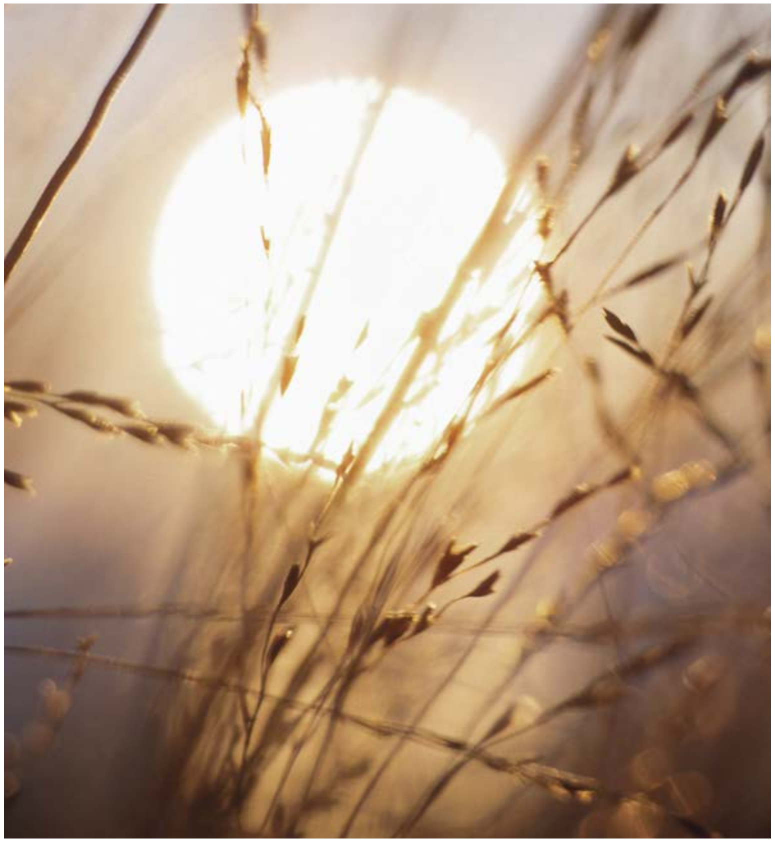

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Correlation

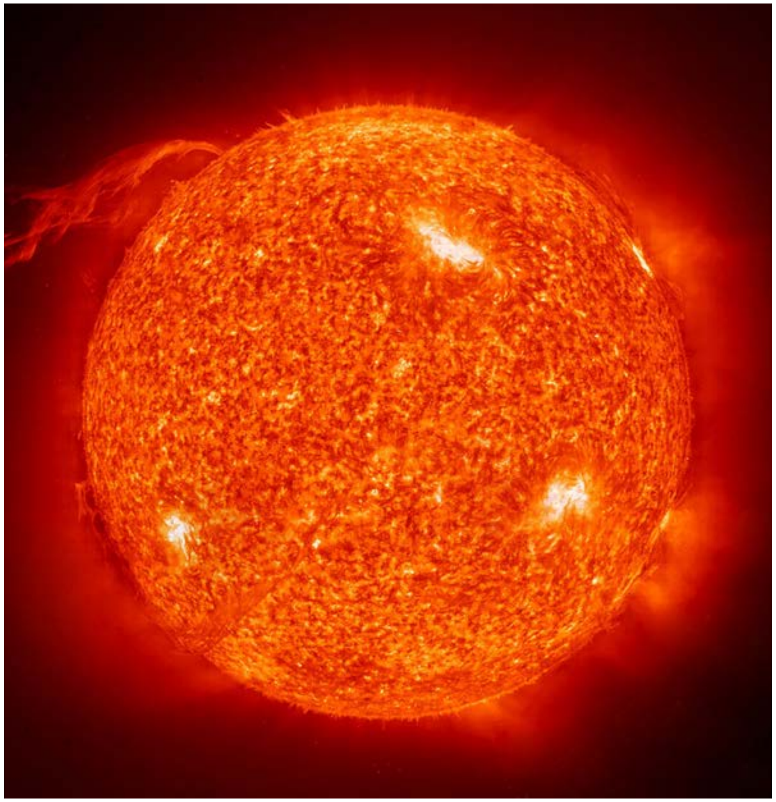
LEVEL V	
Fountas & Pinnell	R
Reading Recovery	40
DRA	40

Solar eclipse

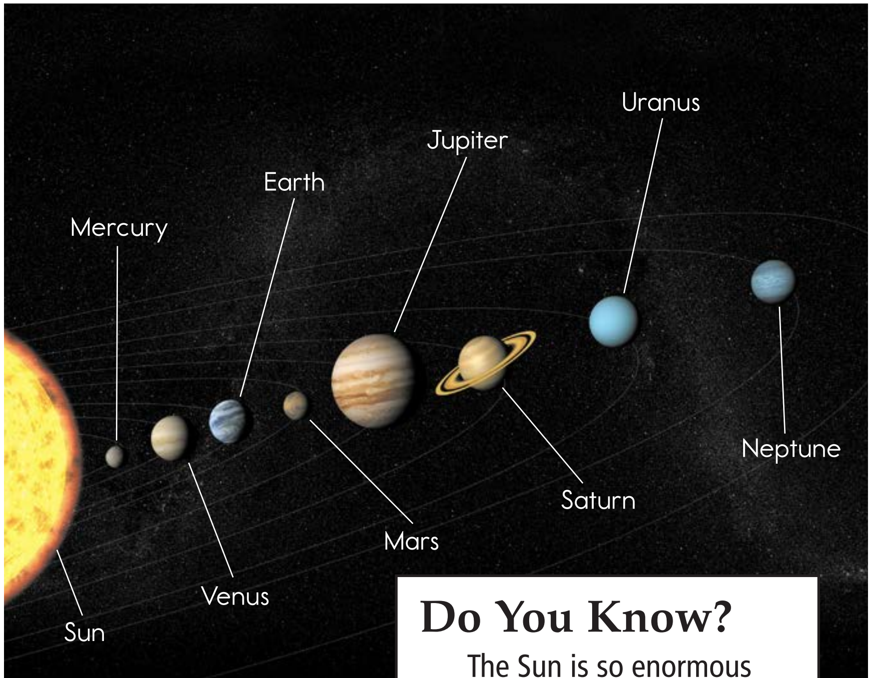
Table of Contents

Introduction

The Sun is a huge ball of flaming gas at the center of our solar system. It's just one of billions of stars in the galaxy, but life on Earth couldn't survive without it. The Sun controls Earth's heat, light, and weather. Scientists know a lot about the Sun and how it affects Earth's inhabitants. Scientists are always learning more and finding new ways to harness the power of the Sun.



The Sun is a raging storm of activity.

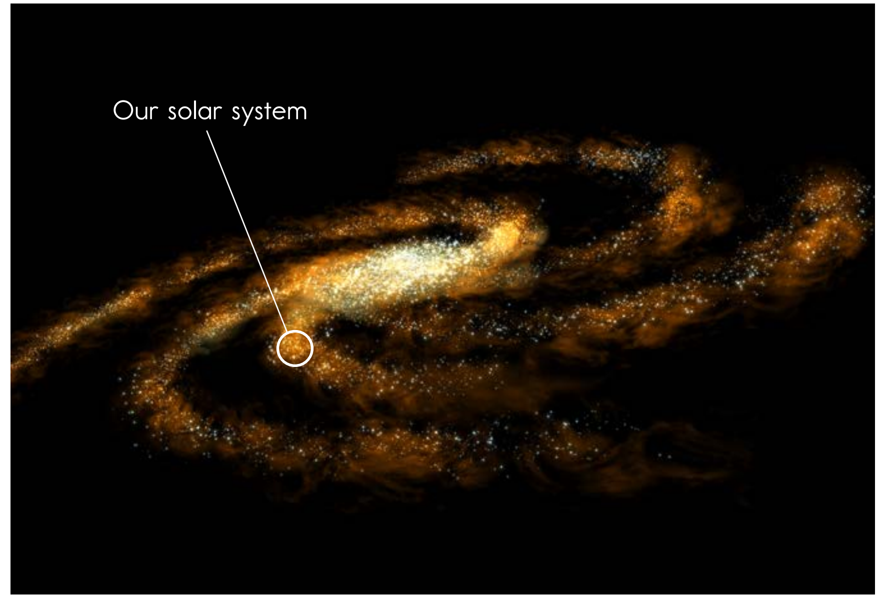


Planets in orbit around the Sun

Do You Know?

The Sun is so enormous that 1.3 million Earths could fit inside it.

The Sun's far-reaching gravity prevents Earth and its seven sister planets from flying off their elliptical orbits into the vast universe. Earth makes one complete **orbit** around the Sun every 365 days, or once every year. If Earth's orbit slowed down, it would become a doomed fireball and crash into the Sun. If Earth's orbit speeded up, it would break free of the Sun's gravity and become a block of ice floating through space. Without the Sun, Earth would be a dark, frozen wasteland void of life.



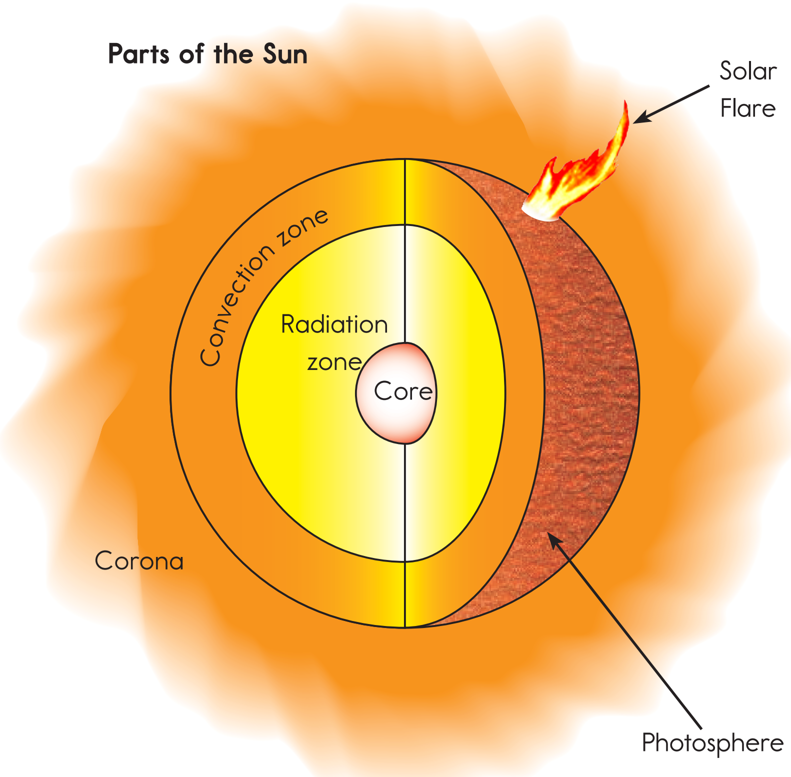
Our Sun and solar system are just a tiny part of the Milky Way.

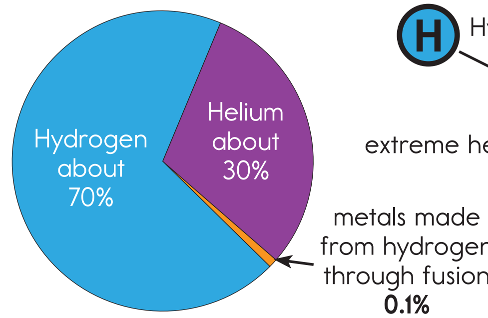
Just Another Star

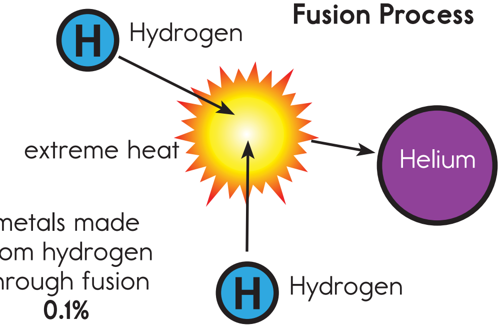
The Sun is just one of billions of stars in the Milky Way galaxy. The Milky Way is made up of a huge collection of stars. Compared to billions of other stars, the Sun is small. Some astronomers call it the *yellow runt*. All stars, including the Sun, are classified by color, size, and brightness. The biggest stars are the hypergiants, which can be more than 1,500 times the size of Earth's Sun. The smallest stars are the very hot white dwarf stars. In between these giant and dwarf stars are the yellow stars, such as our Sun. They are the most common type of stars found in the Milky Way.

Where the Sun Gets Its Energy

Earth's Sun started producing energy shortly after it began forming—estimated to be about 4.5 billion years ago. The Sun started as a gigantic cloud of gas and dust. It began collapsing into a huge ball under the force of gravity. As more and more dust and gas were packed into the giant ball, the pressure around the hydrogen gas at the center increased. This pressure produced extremely high temperatures that triggered a reaction at the center, or core, of the ball.







The fuel in the Sun has kept this reaction going since it started. The energy-producing reaction in the core is called a **thermonuclear reaction**.

A combustible gas called hydrogen makes up about 70 percent of Earth's Sun. Most of the remaining gas is helium. Hydrogen gas is the fuel that produces the Sun's energy. In a thermonuclear reaction, tiny hydrogen atoms combine to form larger helium atoms. This process is called **fusion**. When the hydrogen atoms fuse, they release bits of energy. As trillions upon trillions of hydrogen atoms fuse and release energy, the overall effect is the release of huge amounts of energy.

Do You Know?

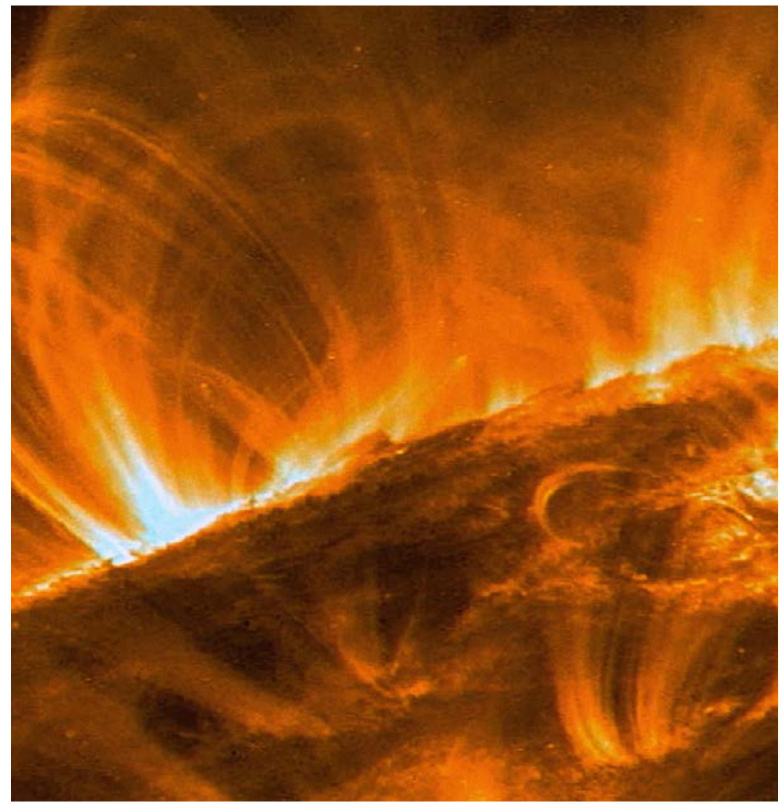
The Sun is so hot that its surface temperature can reach 6,000°C (11,000°F). Compare that to the temperature of boiling water, which is 100°C (212°F), and you get an idea of just how hot the Sun is. It's 60 times hotter!

The energy slowly makes its way from deep in the Sun's core to its surface. It takes hundreds of thousands of years for particles of energy to travel more than six million miles (9.7 million km) from the core to the surface. Along the way, the particles lose much of their energy, and the remaining energy that reaches the Sun's surface is in the form of visible light energy, which is the light we see from Earth.

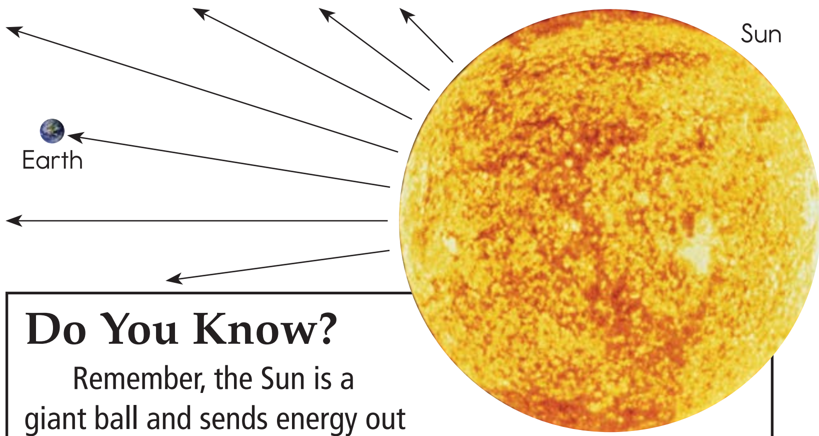
Solar telescopes such as one on Kitt Peak in Arizona allow scientists to take a closer look at the Sun.

Action on the Surface

From Earth, the Sun may look like a gentle, glowing ball, but scientists know that the surface is actually raging with activity. Energy is constantly bubbling to the surface, much like a pot of boiling soup. While the Sun's surface is always a storm of activity, there are times when it is more active than others. In fact, the Sun's activity seems to occur in eleven-year cycles.



Action seen on the Sun's surface, or photosphere, and in the corona



Do You Know?

Remember, the Sun is a giant ball and sends energy out in all directions. Only a tiny fraction of the Sun's energy reaches Earth. Most of it goes off into space.

During active times, scientists observe dark spots moving across the Sun's surface. These areas, called **sunspots**, are cooler than the surrounding gases. They occur where magnetic energy bursts to the surface.

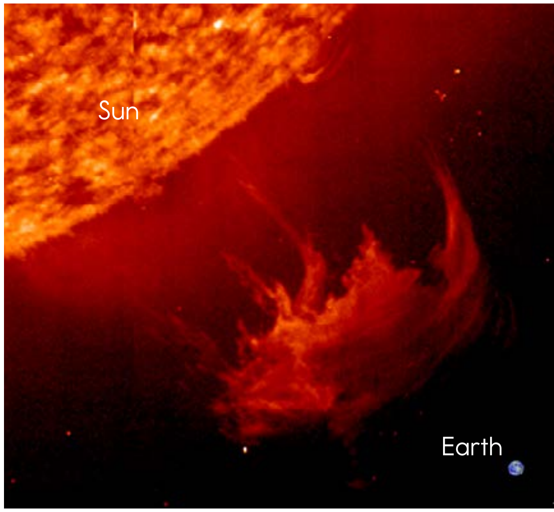
Other solar activities take place during the high points in the Sun's cycle. The most violent are **solar flares**, which are large loops of energy shooting high above the Sun's surface. Some of these flares reach heights of more than 100,000 miles. One of the largest solar flares recorded erupted in 1946 and arched 140,000 miles high.

Solar flare

While solar flares are shooting from the surface, the Sun's corona, or the halo of light around the Sun, becomes very active. Strangely, even though the corona is far above the surface of the Sun, it is much hotter than the surface. The corona reaches temperatures over two million degrees Celsius (3.6 million °F). When the corona is active, it ejects huge masses of **radiation**.

This increased activity of the corona sends waves of high-energy particles sweeping toward Earth. The radiation threatens to disable satellites orbiting Earth that control radio, television, and cell phone communication, as well as electrical power. In 1989, a massive solar explosion knocked out a power grid on Earth, leaving almost seven million people in the United States and Canada without electricity.

Massive blackouts can be caused by solar explosions.



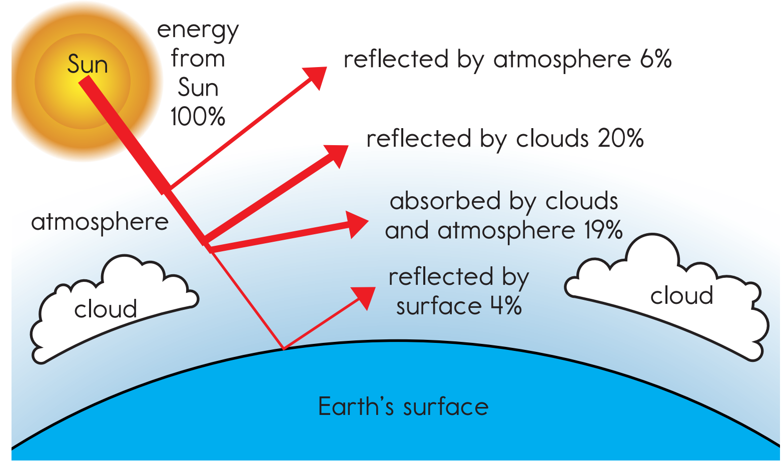
Do You Know?

The Sun is 150 million kilometers (93 million miles) from Earth. That is the same distance as traveling around Earth at the equator more than 3,700 times.

From Sun to Earth

Most people think that heat from the Sun warms the Earth. But heat has to travel through matter to get from one place to another. So while the Sun's energy travels through the vacuum of space, that energy doesn't heat space.

Energy from the Sun travels to Earth as electromagnetic waves called **radiant energy**, which only turn into heat when they are absorbed by **matter**. Examples of radiant energy include visible light, infrared light, and **ultraviolet waves**. About half of the radiant energy we get from the Sun is in the form of visible light. The rest is in the form of infrared and ultraviolet light, which humans cannot see.



About 51 percent of the radiant energy from the Sun is absorbed by Earth's atmosphere and surface.

Radiant energy travels fast—300,000 km per second (186,000 mi per second). At that speed, you could go around Earth about eight times in one second. That's really flying! But even going that fast, it takes energy leaving the Sun eight minutes to make the trip to Earth.

Earth's atmosphere and clouds reflect much of the radiant energy from the Sun before it reaches the surface. When radiant energy gets through, the atmosphere absorbs some of it, heating the air. The energy also hits the surface of the Earth and is absorbed by the land, water, and other matter. When the radiant energy is absorbed, it changes to heat as the visible light or infrared waves agitate the molecules in the matter struck by the waves.

Try This

Which Cup Is Warmer?

Earth's surface heats unequally. Land absorbs the Sun's radiant energy better than water. Dark surfaces absorb energy while light-colored surfaces reflect energy.

Materials:

- flat black paint
- two 16 oz. tin cans (remove labels)
- thermometer
- small paintbrush
- water

Steps:

1. Paint the outside of one can with black paint.
2. After allowing the paint to dry, fill the black can about halfway with water.
3. Fill the unpainted can with an equal amount of water.
4. Place both cans of water in the sunlight for two hours.
5. After two hours, use a thermometer to tell which cup of water is the warmest.

The Sun and Us

Just about all of the energy we use as humans can be linked to the Sun. The energy we get from food comes from plants that use sunlight to grow. So when you eat an apple or a plate of spinach, you're eating the Sun's energy.

The coal, gasoline, and oil we burn for energy comes from the Sun, too. All of these sources of fuel are from plants that grew long, long ago by using energy from the Sun.

Even the energy we get from the wind comes from the Sun. Uneven heating of the Earth's surface by the Sun is what makes the air surrounding Earth move. In essence, the Sun moves sailboats and spins the blades of wind generators.

Windmills turn using wind created by the uneven heating of Earth's surface.

Solar cells collect energy from the Sun.

Scientists have found ways to capture the Sun's energy and use it to heat homes and make electricity.

Solar cells absorb energy from the Sun and change it into electricity. Solar cells are used on calculators. They are also placed on large panels attached to satellites in space. Cities and homes use solar energy for heat in colder months.

Do You Know?

In Germany there is a solar energy power plant that can make enough electricity to power almost 2,000 homes. An area bigger than 37 football fields is covered with 33,500 large solar panels. This power plant uses only solar energy, and it does not pollute the air or water.

Solar collectors are used to produce heat. They are made of black pipes filled with water. The black pipes absorb radiant energy from the Sun. The radiant energy changes to heat and warms the water in the pipes. The water then flows through pipes into a building. Heat radiates out from the water in the pipes and heats the air in the building.

Solar furnaces are used to produce very hot temperatures. They are made of curved mirrors that focus energy from the Sun onto a very small area. The concentrated energy is changed to heat and can reach temperatures of thousands of degrees. The very hot temperatures are used to make new materials and to destroy harmful waste products. Scientists are even planning a solar furnace that will float in space and send focused solar energy back to Earth.

1000 kw solar furnace in Odeillo, France

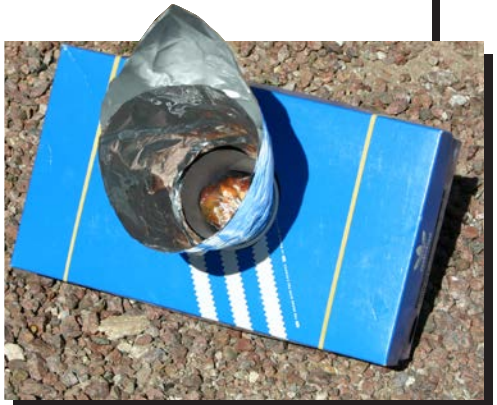
Try This

Solar Cooker

Make your own solar cooker at home!

Materials:

black construction paper
scissors
white foam cup
2 rubber bands
shoebox
sealable plastic baggie
2–3 slices of apple
aluminum foil
newspaper/styrofoam



Steps:

1. Cut a strip of black construction paper to fit the inside of the foam cup.
2. Place the apple slices inside the baggie and seal it.
3. Cut a hole in the lid of the shoebox that is big enough to fit the cup through.
4. Place the cup in the box and surround it with shredded pieces of newspaper or pieces of styrofoam. Use the rubber bands to secure the shoebox lid.
5. Use the foil to make a funnel around the cup as shown in the picture. Keep the foil smooth, making sure the shiny side faces inward.
6. Line the foam cup with the construction paper and place the baggie with apples inside.
7. Aim the foil funnel toward the sun and wait 1–2 hours. Remove the cup and eat your baked apple.

Question: What caused your solar cooker to get hot?

This house takes advantage of solar energy with windows facing south.

Passive solar homes have special features to collect energy from the Sun. These homes have large windows that face the south in the parts of the world north of the equator. They face north in areas south of the equator. During the colder winter months when the Sun is lower in the sky, sunlight passes through the windows and changes to heat when it is absorbed by walls inside the house.

As important as the Sun is to our survival, it also poses dangers to humans. We are learning more and more about how solar energy damages our skin. A skin cancer, called *melanoma*, is caused by overexposure to the Sun's harmful ultraviolet rays. Years of exposure and severe sunburns can damage skin cells. It is important to wear sunscreen and clothing that covers your skin when you are out in the Sun, especially for long periods of time.

Do You Know?

Never look directly into the Sun. The Sun's powerful rays can burn the cornea, the sensitive area of your eyes that makes it possible for you to see. Damage to the cornea can cause blindness.

Even sunglasses can't completely protect your eyes from the Sun.

The Sun's Death

Each day fusion changes more and more of the Sun's hydrogen fuel into helium. Scientists estimate that the Sun has about five billion years of fuel left before it will begin to cool down and eventually die.

Ring Nebula—what Earth's Sun could look like when it dies

Conclusion

We depend on the Sun for our survival. It is the source of most of the energy we use every day. Scientists are working hard to better understand the Sun and its energy. Satellites orbiting Earth collect data from the Sun. Better solar telescopes being developed on Earth are aimed at the Sun to collect data. As we understand the Sun better and find new ways to use its energy, we will grow even more dependent on the power of the Sun.

Glossary

fusion	blending of atoms that results in the release of energy (p. 8)
matter	a substance that takes up space and has weight (p. 13)
orbit	a path taken by a body, such as the Earth, around another body, such as the Sun (p. 5)
radiant energy	energy traveling in electromagnetic waves, such as infrared, visible light, or radio waves (p. 13)
radiation	process of giving off energy in the form of rays, such as light or heat (p. 12)
solar cells	structures made from silicon or plastic that absorb light energy from the Sun and turn it into electricity (p. 17)
solar flares	sudden energy bursts that appear as large bright loops on the Sun's surface (p. 11)
sunspots	cooler, dark spots on the Sun's surface that eject magnetic energy (p. 11)
thermonuclear reaction	energy released as a result of hydrogen atoms combining to form helium atoms (p. 8)
ultraviolet waves	radiant energy waves similar to light, but which cannot be seen by humans (p. 13)

Explore More

On the Internet use *www.google.com* to find out more about topics presented in this book. Use terms from the text, or try searching for glossary or index words.

Some searches to try: *solar energy*, *sunspots*, or *thermonuclear reaction*.

Index