

**SUPER-POWERED
EARTH**

ENERGY from the **Rays of the**

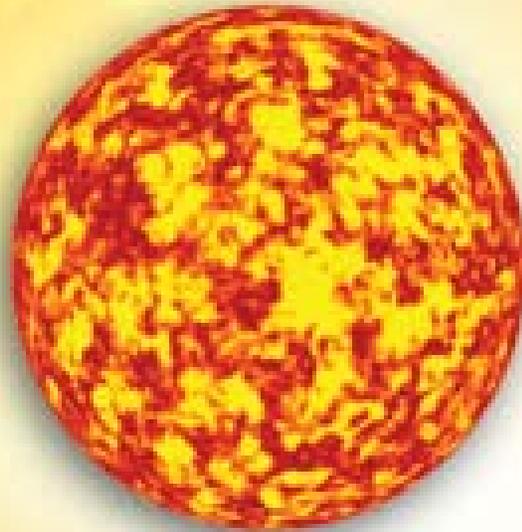
SUN



**SOLAR POWER: EVERYTHING YOU EVER WANTED
TO KNOW ABOUT CLEAN, GREEN POWER!**



Ministry of New and Renewable Energy
Government of India



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Message

India has witnessed healthy economic growth during the last few decades. This progress has resulted in faster consumption of our natural resources. Increasing exploitation of fossil fuels such as coal, oil and natural gas has led to various environmental problems such as global warming and climate change.

As a nation, we need to adopt a sustainable path of development, not just for our continuing economic growth, but also to protect the environment. Increased use of renewable energy sources, coupled with energy conservation, will lead to sustained supply of energy and sustainable development. The promotion of renewable energy sources in the country needs widespread publicity, so that these can be accepted and adopted by people at large.

As future citizens, children can make a major contribution in protecting the environment and natural resources. They can take the lead in organizing actions that support conservation of resources and greater use of renewable energy sources at the community level.

It gives us immense pleasure to put forth this series of books on renewable energy sources. We hope that children who read these books will not only enjoy them greatly, but also feel inspired to bring about a positive change, so that we leave a healthy and beautiful world for generations to come.



R K Pachauri
Director-General, TERI
Chairman
Intergovernmental Panel on
Climate Change



Shri Vilas Muttemwar
Minister of State
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Government of India

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What is the sun?

Guess who hasn't taken a day off for billions of years? The sun. It has been working – shining bright, giving us light and heat – for about 4.6 billion years.

Centre stage

About 4.6 billion years ago, a hydrogen cloud collapsed and formed the sun. The sun is actually a star. It is located at the centre of the solar system. It makes up more than 99 per cent of the total mass of the solar system. Other planets, including the earth, and asteroids account for the rest. The sun measures about 1.392×10^9 metres across, which makes it about 109 times the size of the earth. The sun is not the biggest star, but it appears the biggest to us. This is because it is closer to the earth than other stars—just 150,000,000 kilometres away from the earth.

Chromosphere

Convective zone

Photosphere

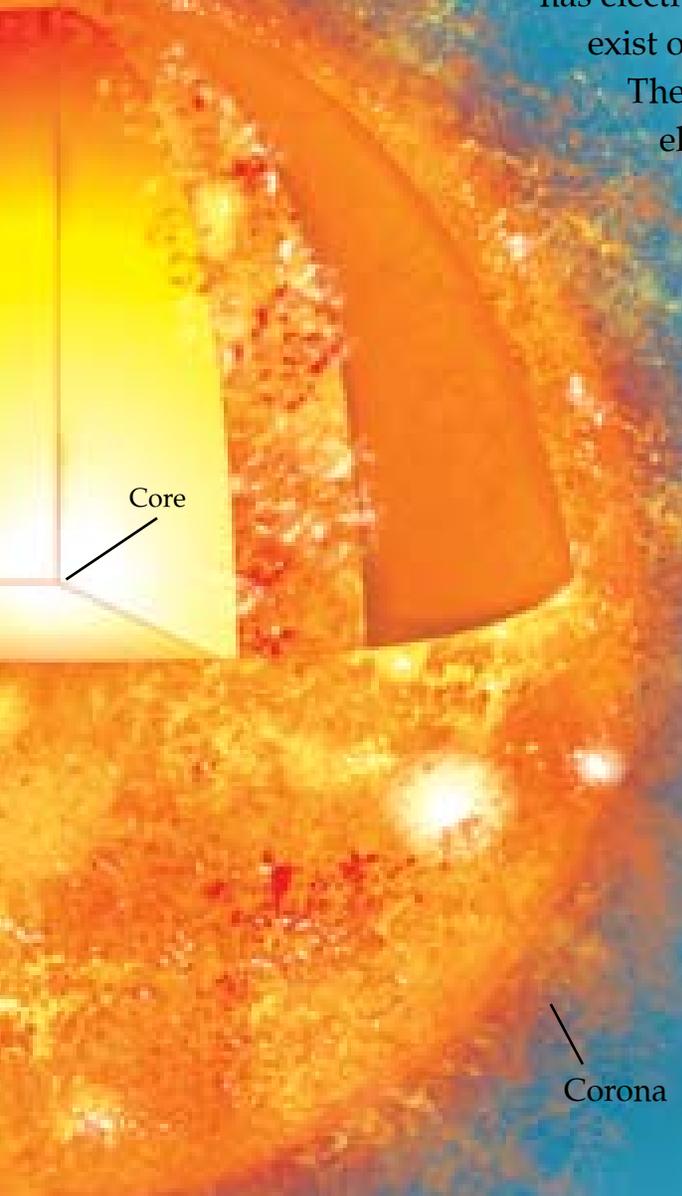
Radiative zone

←.....
The sun is extremely hot. The centre of the sun has a temperature measuring fifteen million degrees Celsius.

What a strange ball!

Although the sun looks like a ball, it does not have a definite shape. It is actually an orb of gas and plasma—the fourth state of matter (the other three are solid, liquid, and gas) and a form of gas that has electrical charge. The sun is so hot that nothing solid can exist on it. About 74 per cent of its mass is hydrogen.

The rest is helium, with traces, or tiny amounts, of other elements like oxygen, carbon, iron, sulphur, neon, boron, lithium, beryllium, nitrogen, silicon, and magnesium. However, some scientists believe it has just 34 per cent hydrogen and 64 per cent helium.



Great ball of fire!

How do we know what the core of the sun is like? Helioseismology, or the study of the sun's structure, uses infrasound waves to learn more about this blazing ball.



Look who's hot!

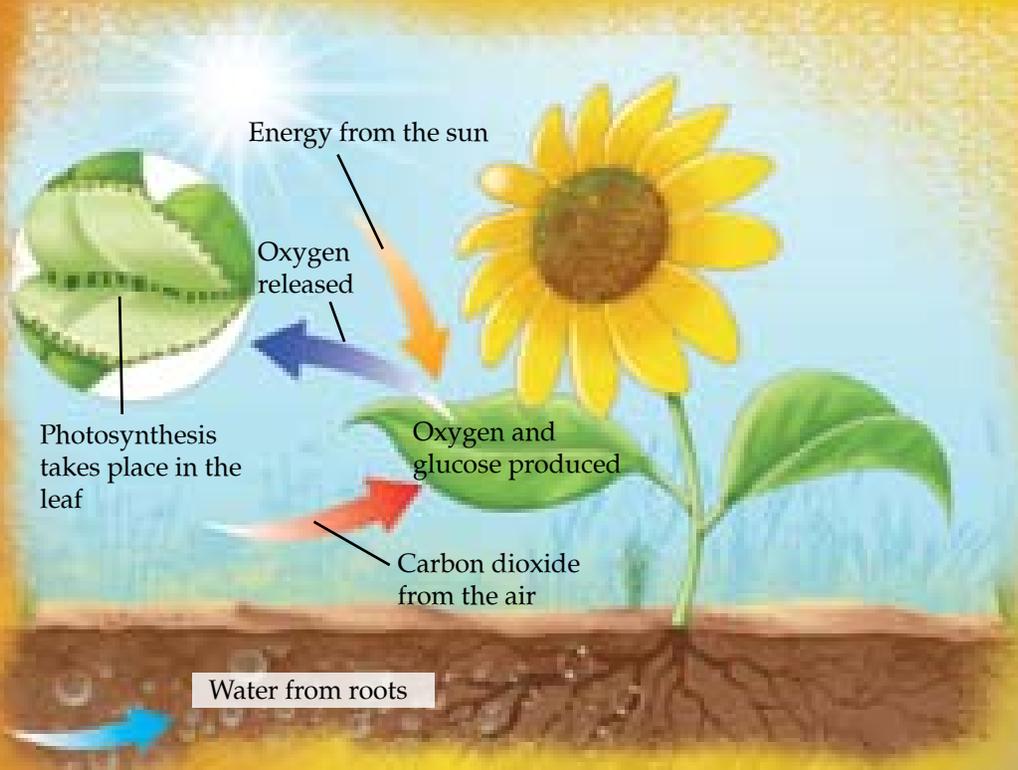
The sun is made up of several layers. Right at its centre is the core, the hottest layer. To measure all that heat, you'd need a thermometer that can go up to about fifteen million degrees Celsius! The heat is caused by nuclear reactions. The surface temperature of the sun is about 5,500 degrees Celsius, while that of the outer atmosphere, or the corona, is one million degrees Celsius. The sun also has cool regions, called sunspots, which can be thousands of kilometres wide!

What is solar energy?

Watch a clock with a seconds hand. Every time the hand moves, the sun burns up about four million tonnes of matter and releases huge amounts of energy.

Solar-powered earth!

Solar energy gives us both heat and light. However, not all of this energy reaches the earth. We receive only one-billionth of what is produced. But even this small amount of energy is virtually the source of life on the earth. The heat from the sun warms up the earth's land surface, water bodies, and the air above. It causes the wind to blow and the seasons to change. The sun, along with the moon, also causes the tides.



←.....
All living beings depend on plants for food. Plants use energy from the sun to prepare food by a process called photosynthesis. In this process, the sun's energy is converted into chemical energy.

The strongest one!

The sun is the ultimate source of energy. Fossil fuels like coal and petroleum have the sun's energy stored in them. So, it is this energy that we use when we burn fossil fuels or biomass, or use wind or wave energy. We use solar energy to produce heat, light, and electricity. Even our bones need sunlight for strength!

Earth, here I come!

Although we cannot see the sun at night, some part of the earth is always facing the sun. This means, the earth is always receiving solar energy. As solar energy travels from the sun to the earth, some of it is absorbed by the atmosphere. Some of it is reflected back from the atmosphere by the clouds. Drops of moisture in the clouds and even dust absorb the heat of the sun. So, altogether, about 16 per cent of the energy is absorbed by the earth. That's still a whopping amount of energy.



▲ *Sunlight is very bright. So, you should not look at the sun without wearing protective glasses. It can hurt or even damage the eyes.*



Can the sun burn forever?

It depends on how long you believe forever is! Scientists believe the sun has reached a little less than half its age. Once the hydrogen and helium are burnt up, the sun will cool down, gobble up the earth, and become a tiny white star.

▼ *Fossil fuels will get exhausted one day, unlike solar energy, which will last forever.*



Why's the sun fun?

Millions of years ago, during the Carboniferous period (354–290 million years ago), huge swamps were full of algae and water plants. As these plants and algae died, they sank to the bed of the swamps.

Swamped over

Over a period of time, other matter like soil and sand covered the dead plants and weighed them down. The plant matter became fossilized over the ages and turned into fossil fuels like coal, oil, and natural gas.

Some of it is good!

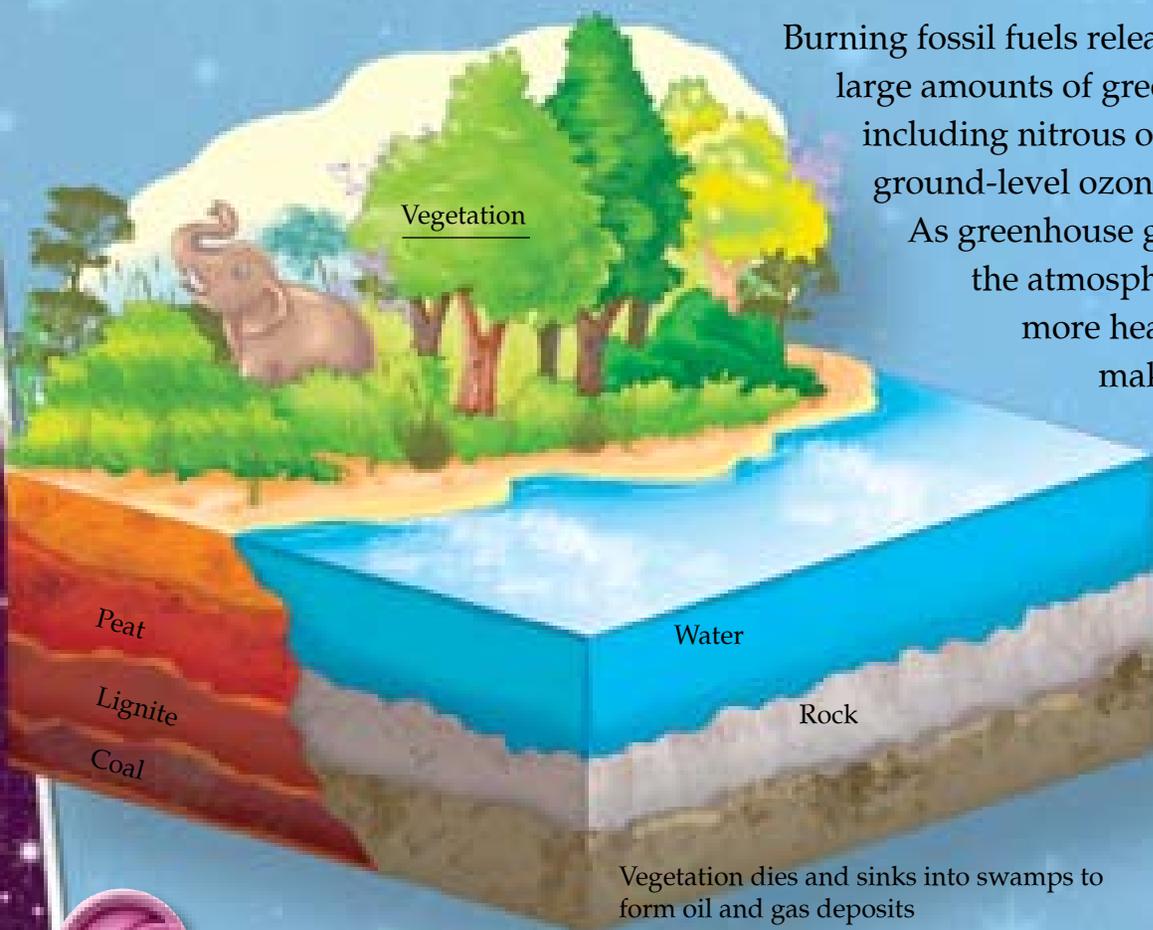
The earth's atmosphere is made up of several gases. Some of these, like carbon dioxide, methane, and water vapour, are called greenhouse gases. They allow the sun's rays to come in but the heat generated is not allowed to escape. This is the natural greenhouse effect. If it hadn't been for these gases like carbon dioxide, the earth would have been too cold to live on.

Burning fossil fuels releases unnaturally large amounts of greenhouse gases, including nitrous oxide and ground-level ozone, into the air.

As greenhouse gases increase in the atmosphere, they trap more heat from the sun, making the earth warmer.

Fossil fuels were formed from plants and animals that lived three hundred million years ago in primordial swamps and oceans.

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