The Universe in my pocket

Our star the Sun

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THE UNIVERSE IN MY POCKET

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The Sun is our main source of light and heat, and it is thanks to the Sun that there is liquid water on Earth.(Nexus)

Plants such as rice, which is the world's main food, exist thanks to the energy they store from the Sun (Agroemprsario.com).

The Sun: our source of life

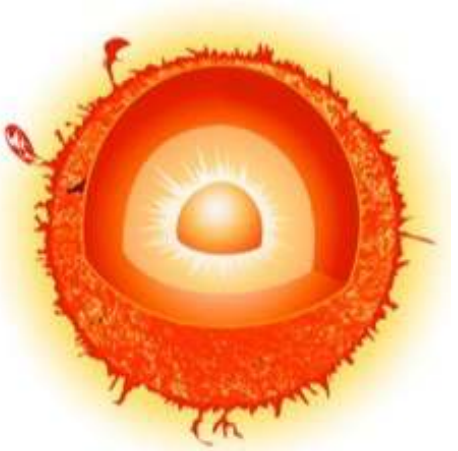
The Sun is our main source of energy. For example, green plants use solar radiation to produce sugar and starch, which is used to feed animals and humans.

The Earth is at the ideal distance from the Sun to have liquid water on its surface. Earth's gravity is sufficient to hold it.

Life exists on Earth thanks to the elements that compose it, to water, and to the energy produced by the Sun.

Our lives are organized around day and night: when there is sunlight, and when there isn't.

Plants and animals live according to day and night. In general, humans sleep at night.



The energy that reaches the Earth is produced in the Sun's core (Vector Stock).

Stromatolites are the oldest known form of life on our planet.
(Getty images)

Not only humans, dogs and other vertebrates are intelligent. Octopuses, which are molluscs, appeared on Earth before the dinosaurs, and are very intelligent. This octopus is opening a bottle (Octolab).

The Sun as an energy provider

Like all stars, the Sun produces energy within itself. After a long journey through all its inner layers, this energy reaches the surface, from where it travels through space in the form of light and other types of radiation until it reaches the Earth.

The Sun is a stable star: it has maintained about the same temperature for billions of years. Because of this stability, life on Earth has been able to develop. Life on our planet has evolved from single-celled beings to plants and intelligent animals.

As we improve and implement technolgies to capture solar energy, we can reduce the burning of fossil fuels, which is damaging to the environment.

Water droplets from rain break sunlight up into different colours we then see as a rainbow (see TUIMP 2). (Meteored)

The Sun also emits light that is invisible to our eyes, such as ultraviolet rays that tan us. X-rays and radio waves are emitted during solar storms.

Mosaic of images of the Sun (false colours) in various components of its invisible light.

The images were taken by NASA's Solar Dynamics Observatory (SDO) whose goal is to predict solar variations that affect life and communications on Earth.

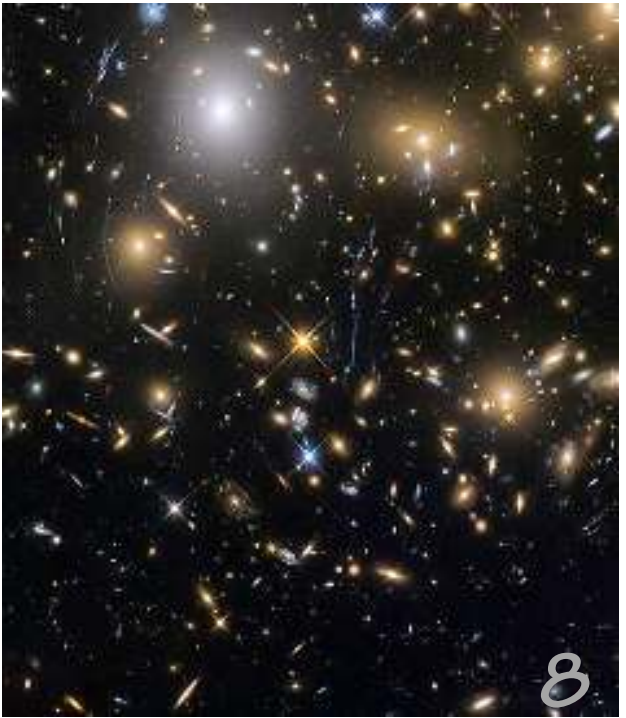
How the Sun generates energy

The Sun is composed mainly of hydrogen. In its core, whose temperature is 15 million degrees Celsius, nuclear fusion reactions take place. Here, hydrogen atoms combine to form helium (see TUIMPs 14 and 29).

This fusion process produces energy. After a long journey through the interior of the Sun, this energy reaches the surface. There, the lower-density gas of the solar atmosphere is transparent and the energy can escape as visible light. That is why the Sun shines. Its surface is at 5,500 degrees; objects at this temperature emit most strongly in yellow light.

Knowing the mass of the Sun (about 300,000 times that of the Earth), the energy released by each hydrogen atom and the amount of light the Sun emits every second, we can deduce how long it will take the Sun to consume all its fuel: the Sun will shine for about 10 billion years.

This is what our Galaxy would look like if we could observe it from above (left). The Sun is in one of the spiral arms, which we see as a bright band in the sky: the Milky Way (right). Our Galaxy contains about a hundred billion stars (NASA/JPL and Stephane Guisard).



This is an image of the sky taken by the Hubble Space Telescope after 12 hours of observation. The galaxies are so far away that they look like little clouds. There are about a hundred billion galaxies in the Universe.

The Sun: one of many stars

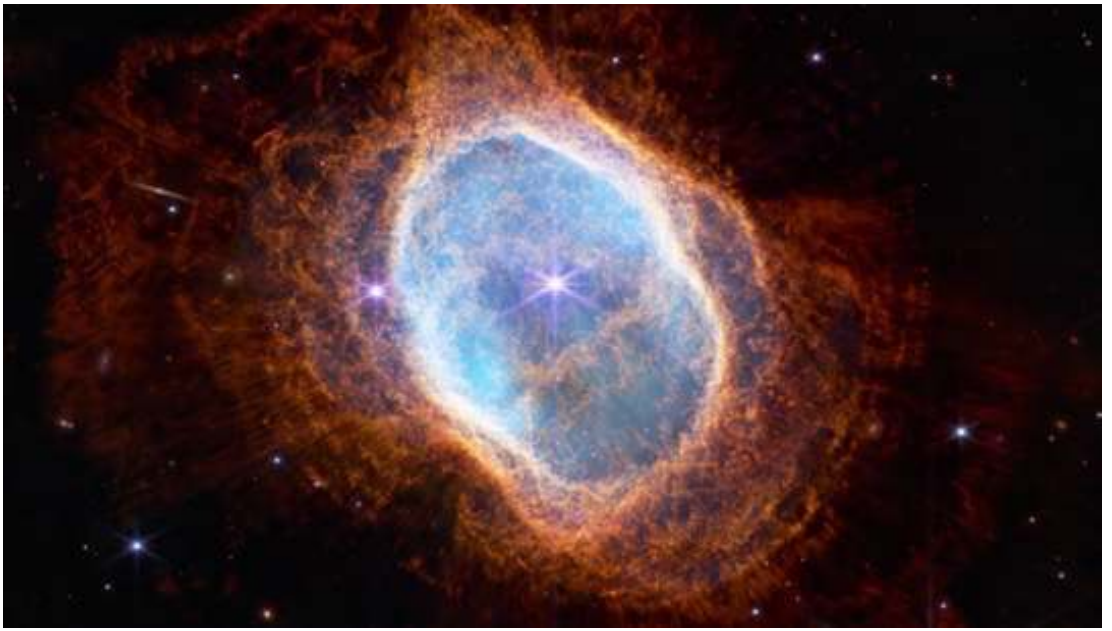
The Sun is one of about one hundred billion stars in our Milky Way galaxy - which is just one of about one hundred billion galaxies that exist. One out of every 100 stars is similar in size and mass to the Sun.

Because the Sun is the closest star, it is the reference for studying other stars. Astronomers analyse the differences and similarities between the Sun and other stars to better understand stars in general.

More massive stars, with more matter, live shorter lives than the Sun because they use up their fuel very quickly. Given their short existence, it is difficult for life to develop on planets close to these stars.

Lower-mass stars live longer, so their planets - under ideal conditions - could be home to life and civilisations.

Stars and their planets form within clouds of gas and dust in the interstellar medium (Webb/NASA).



The planetary nebula NGC 3132, called the Southern Ring Nebula (Webb/NASA).

Life and death of the Sun

The Sun, like all stars, formed inside a cloud of gas and dust. For some reason, perhaps the explosion of a nearby supernova, the cloud contracted and increased in density. Much of the cloud material went into the Sun, the rest clumped together to form bodies that do not shine on their own, but only reflect light: the planets, their satellites, asteroids and comets.

Stars like the Sun eventually expand in size and eject their atmosphere while their core contracts into a very hot star that illuminates the expanding sphere of gas. A planetary nebula appears, like the one shown in the illustration (see TUIMP 36).

The Imilac meteorite fell to the Chilean Atacama Desert in 1822 and is more than 4.5 billion years old.

Several people from Chihuahua in Mexico saw fragments of the Allende meteorite fall in 1969. It is 4.6 billion years old.

The Erg Ech meteorite found in Algeria's Sahara desert in 2020 is more than 4.6 billion years old.

How much longer will the Sun live?

We already know that the lifespan of the Sun is about 10 billion years.

To know how much longer it will live we need to know how old it already is. Its age is the same as the age of the Solar System.

This can be measured from the amount of elements from the decay of radioactive elements observed in ancient terrestrial rocks or in meteorites (which are pieces of asteroids that have fallen to Earth).

For example, by measuring the amount of strontium and rubidium the meteorites contain, we can calculate the minimum age of these rocks, because we know the rate at which rubidium decays into strontium.

The measurements give an age of about 4.6 billion years; it follows that the Sun will live for another 5.4 billion years.

Images of the Sun

across continents

Images of the Sun

The Sun
and Immortal birds
ancient Shu village
China

The Smiling Sun
Matylda, France
5 years old

Mask-Sun
Bwa
Burkina Faso

across continents

The woman
living in the Sun
Ashevak Kenojuak
Cape Dorset, Canada

Flag of the
Aborigines of
Australia

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Julieta Fierro and Grażyna Stasińska wrote this booklet in 2024. Julieta works at the National University of Mexico and Grażyna at the Paris Observatory.

The cover image is the Sun as photographed by NASA's Solar Dynamics Observatory (SDO). The colours are false because the photo was taken in the extreme ultraviolet, i.e. radiation that has more energy than the ultraviolet that produces sunburn.

To learn more about this collection and the topics presented in this booklet you can visit http://www.tuimp.org.

Translation: Stan Kurtz