

The Sun

The SUN is a ball of hot gases. By weight, it is 70% hydrogen, 28% helium, 1.5% carbon, nitrogen, and oxygen, and 0.5% all other elements, this changes slowly over time as the Sun converts hydrogen to helium in its core. The Sun's temperature is 10,000 degrees Fahrenheit at the surface and 27,000,000 degrees Fahrenheit at the centre.

It is often said that the Sun is an "ordinary" star. That's true in the sense that there are many others similar to it. But there are many more smaller stars than larger ones; the Sun is in the top 10% by mass. The median size of stars in our galaxy is probably less than half the mass of the Sun. The outer layers of the Sun exhibit differential rotation: at the equator the surface rotates once every 25.4 days; near the poles it's as much as 36 days. This odd behaviour is due to the fact that the Sun is not a solid body like the Earth. Similar effects are seen in the gas planets. The differential rotation extends considerably down into the interior of the Sun but the core of the Sun rotates as a solid body.

The conditions at the core (approximately the inner 25% of its radius) are extreme. The temperature is 15.6 million Kelvin and the pressure is 250 billion atmospheres. At the centre of the core the Sun's density is more than 150 times that of water.

The Sun's energy output (3.86×10^{33} ergs/second or 386 billion billion megawatts) is produced by nuclear fusion reactions. Each second about 700,000,000 tons of hydrogen are converted to about 695,000,000 tons of helium and 5,000,000 tons of energy in the form of gamma rays. As it travels out toward the surface, the energy is continuously absorbed and re-emitted at lower and lower temperatures so that by the time it reaches the surface, it is primarily visible light. For the last 20% of the way to the surface the energy is carried more by convection than by radiation.

The surface of the Sun is called the photosphere, and it's temperature is about 5500 K. There are "cool" regions called Sunspots, only 3800 K, Sunspots can be very large, and as much as 50,000 km in diameter. Sunspots are caused by complicated and not very well understood interactions with the Sun's magnetic field.

The region above the chromosphere, called the corona, extends millions of kilometres into space but is visible only during a total solar eclipse. Temperatures in the corona are over 1,000,000 K.

The Sun's magnetic field is very strong (by Earth standards) and very complicated. Its magnetosphere (also known as the heliosphere) extends well beyond Pluto.

The Sun also emits a low density stream of charged particles, the majority are protons and electrons, which are also known as "Solar Winds" which travels throughout the solar system at about 450 km/sec. The solar wind and the much higher energy particles ejected by solar flares can have dramatic effects on the Earth ranging from power line surges to radio interference to the beautiful aurora borealis.

There was a period of very low sunspot activity in the latter half of the 17th century called the Maunder Minimum. It coincides with an abnormally cold period in northern Europe sometimes known as the Little Ice Age. Since the formation of the solar system the Sun's output has increased by about 40%.

The Sun is about 4.5 billion years old. Since its birth it has used up about half of the hydrogen in its core. It will continue to radiate "peacefully" for another 5 billion years or so (although its luminosity will approximately double in that time). But eventually it will run out of hydrogen fuel. It will then be forced into radical changes which, though commonplace by stellar standards, will result in the total destruction of the Earth (and probably the creation of a planetary nebula).

Sun Data

Diameter: 1.4 million km (870,000 miles)

Mass: 330,000 x Earth

Density: 1.41 (water=1)

Solar Wind Speed: 3 million km/hr.

Solar Cycle: 8 - 11 years

Core Temperature : 14 million °C (22.5 million °F)

Rotation Period at Equator: 25 Earth days

Age: 4.5 billion years

Distance from Earth: 149.6 million km (93 million miles)

Distance to Nearest Star: 4.3 light years

Closest Star: Proxima Centauri (Alpha Centauri C)

Luminosity: 390 billion billion megawatts

Temperature at surface: 5,500 °C (9,932 °F)

Temperature of Sunspots: 4,000 °C (7,232 °F)

Rotation Period at Poles: 35 Earth days