

Warm up to the Solar System's Furnace



Solar Surface through Hydrogen Alpha Filter – PAA Member Brian McGaffney

Ancient cultures were often Sun worshipers, and rightly so. The Sun provides heat and light. Take away the Sun and we're in complete darkness, frozen solid at -200 degrees Celsius.

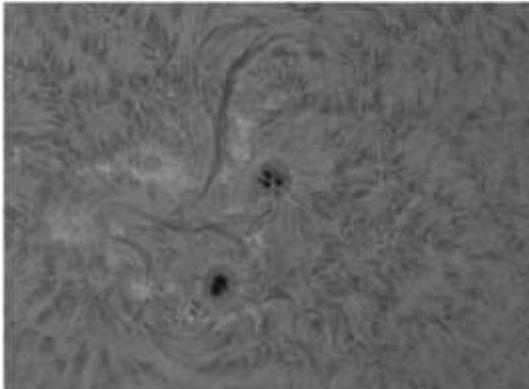
Within the Sun's rays are vitamins D, K and E that are essential to our health. More importantly the Sun's rays stimulate photosynthesis so that crops grow for us and for the cows in the pasture that will provide the glass of milk to partner with your cookies. From an aesthetic side photosynthesis also gives us the trees for shade and lumber for building. The same goes for the flowers that fill your gardens with bursts of colour. Take away the Sun and you take away life and much of what makes it enjoyable.

The Sun's light reaches all of the planets in our solar system. Even distant Dwarf Planet Pluto receives enough Sunlight to give it seasons. We'll get to that when we cover Pluto. The Sun does something equally as important as supporting life on Earth. It is also the gravitational hub of our solar system. The Sun's incredible gravitational pull keeps the planets, asteroids, dwarf planets and all their moons in orbit around it.

Compared to Earth, the Sun is over one million times larger. Along with the Sun's incredible size comes mass and that's what give the Sun such powerful gravitational pull. But despite all that big talk, our star is classified as a lowly G2 yellow dwarf.

If you like statistics, here are some enlightening facts about old Sol:

1. The Sun is a star just like the ones that twinkle at night, only its closer.
2. The Sun is on average 143,000,000 Km from Earth
3. It takes 8 minutes and 13 seconds for the Sun's light to reach us.
4. The Sun's diameter is 1,392,000 Km.
5. The Sun's mass is equal to that of 99.8% of our solar system.
6. The temperature on the Sun's surface is nearly 6,000 degrees Celsius.
7. The Sunspots on the Sun's surface are a balmy 5,000 degrees Celsius.
8. The temperature at the Sun's core is 13,600,000 degrees Celsius.



The Sun's roiling surface comes to life in this image taken with a hydrogen-alpha filter. Visible are two Sunspots, either of which could hold the Earth three times over. Also visible are filaments skittering across the Sun's bubbling surface.

Image by PAA member Brian Colville

The Sun produces its energy by a process known as nuclear fusion. If that term sounds remotely familiar, it's because nuclear fusion is the process behind the hydrogen bomb – but it's a lot more folks friendly in this case.

The Sun is 74% hydrogen and 24% helium with the balance of its make up being oxygen, carbon, iron and neon. At the Sun's core the temperature is over 13 million degrees Celsius and the pressure is over 340 billion times that of Earth's atmosphere. It's not a great place for shopping, but it's perfect for fusing four hydrogen nuclei into one helium atom. When that fusion happens a bit of energy is released as a by product.

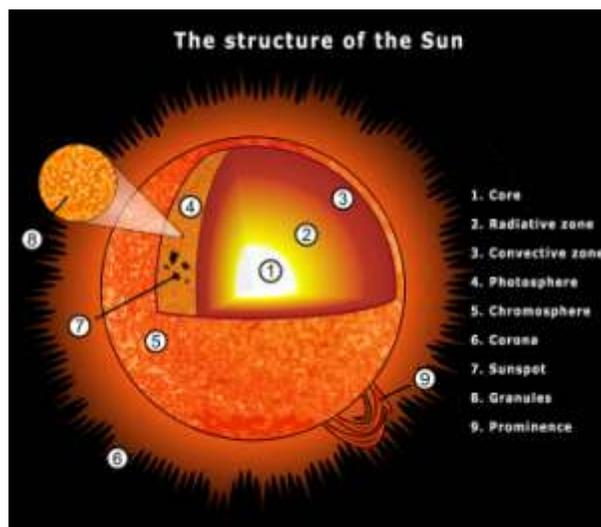


Illustration from imgarcade.com

Actually quite a bit of energy is released. The Sun's energy output equals 100 billion tons of TNT every second. That's the total energy output of the human race since the first cave people lit a fire up to now – in just one snap of your fingers. Put another way, you could light 64 100-watt light bulbs with the energy from just one square centimetre of the Sun's surface.

The Sun has been punching out those numbers for a large part of the last 4.6 billion years and will continue doing so for many millenniums in the future. But it won't go on forever. Even stars die and at 4.6 billion years old our star is middle aged. The average G2 yellow dwarf star lives for about 10 billion years. Unfortunately the bad news for us will begin in about a billion years.

Like people, as a star gets older, it also gets bigger and bigger. As a result the Earth will get hotter and hotter. The lakes and oceans will boil away and prior to that it will be too hot for the life forms we know today to survive. In short, Earth will be reduced to a big fried dirt ball. But the story isn't over yet. The Sun will keep on growing until it bloats out to the orbit of Jupiter. Along the way the Sun will puff off layers of its outer atmosphere. At its maximum girth the Sun will have swallowed up Mercury, Venus, Earth, Mars and the asteroid belt along with newly crowned Dwarf Planet Ceres. So the Sun which originally gave us life will ultimately destroy us.

And what happens after that? In a few more billion years the Sun will run out of Hydrogen and begin fusing other materials to avoid core collapse. But once it reaches iron, its game over. Iron does not give out any energy to hold the Sun's core up. So the Sun's core will collapse within a second to form a beautiful planetary nebula with a white dwarf star at its centre. It won't be as flashy as a Supernova, but it will be a celestial tombstone for our solar system and the Sun that gave it birth and life.



M57 (The Ring Nebula) – the remains of an expired star about the size of our Sun. Imaged by PAA Member Brian McGaffney at his observatory in Apsley, Ontario.