St Aiden's Homeschool

Our Solar System

The Sun

Compiled by Donnette E Davis
www.staidenshomeschool.com

The Sun

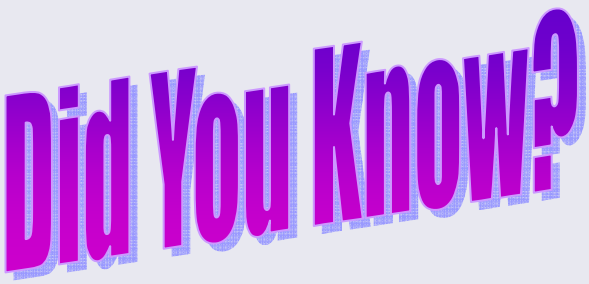
Sun Facts

Never look directly at the Sun

- If you looked at the Sun in a telescope, you could go blind.
- The Sun is 150,000,000 km (93 million miles) away from Earth.
- The Sun's light takes 8 minutes to reach us on Earth. That means that if the Sun blew up, we wouldn't see it blow up until 8 minutes later!
- The temperature of the Sun's light decreases as it travels farther.
- Every second, the Sun turns over 4 million metric tons of gas into energy. That's 881,849,000,000 pounds!
- The Sun is as wide as 109 Earths.
- The Sun is so hot that a piece of it the size of a pinhead could kill someone 160 km (100 miles) away.

The Sun is a star—the closest one to Earth. It is a large ball of very hot gas. The air we breathe and the Helium in a balloon are both gases. It is over 5,500 °C at the surface, and much hotter at the center, about 15 million °C. The Sun is made of mostly hydrogen (70%) and helium (28%). It turns much hydrogen into helium every second, thus creating heat and light.

The Sun makes light and heat that warms the surface of the Earth and allows plants to grow. We can get food from plants, and we can burn wood and other parts of plants to cook, warm our houses, and make cars go. Without the Sun there would be no life on Earth.



Some people from long ago thought of the Sun as a god. They did not want the god to be angry with them. To keep the Sun happy, they offered it gifts such as gold and food.

In a Nutshell:

The Sun is our closest star. It is a member of the Milky Way galaxy. The Sun is a yellow dwarf star, which means it is a medium size star. It is believed to be over 4 billion years old. The Sun spins slowly on its axis as it revolves around the galaxy.

The centre, or core, of the Sun is very hot. A process called "nuclear fusion" takes place there. Nuclear fusion produces a lot of energy. Some of this energy travels out into space as heat and light. Some of it arrives at Earth! Streams of gas particles known as the solar wind also flow out from the Sun.

On the Sun's surface, we can see storms. We call these storms "sunspots" because they look like dark spots on the Sun's surface. The Sun also produces big explosions of energy called solar flares. These flares shoot fast moving particles off the Sun's surface. These particles can hit the Earth's atmosphere and cause a glow called an aurora.

Q: A Question

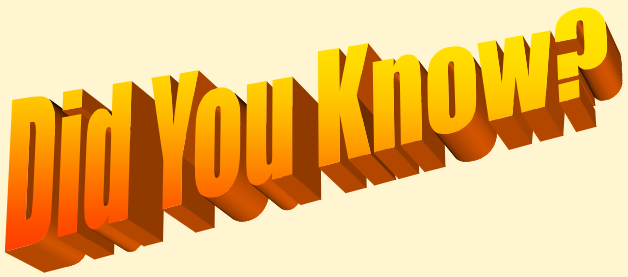
A sunspot is a _____?

1. solar flare
2. vacation spot
3. Sun storm

A: 3) Sun storm. A sunspot is a special type of storm on the Sun's surface.

Fast Facts about the Sun

Revolution Period Around the Galaxy	250 million Earth years
Rotation Period	Equatorial Region - 25 Earth days Polar Regions - 36 Earth days
Equatorial Diameter	1.39 million km
Gravitational Pull	28 times that of Earth



Heat from the centre of the Sun takes a million years to reach the Sun's surface. Once the heat leaves the Sun's surface, though, it only takes it 8.5 minutes to reach Earth!

Sing a Song About The Sun

Our star, the Sun is a big ball of gas
And it's 99 percent of our solar system's mass
It's an average star in our Milky Way
Warming the Earth every day

What powers our Sun and makes it so bright?
Come on and tell me, what makes all that light?
Hans Bethe long ago reached the conclusion
It changes Hydrogen to Helium by nuclear fusion

When fusion takes place light is created
And it makes its way out (although rather belated)
Through the Photosphere that's the part that we see
The light comes out and shines on you and me

About a million Earths could fit in the Sun
But if you were there you wouldn't have much fun
It's six thousand degrees at the photosphere
And much hotter inside the solar atmosphere

How big is the Sun?

The Sun is very big - much, MUCH bigger than the Earth! It is more than a million km (109 Earths) across and contains more than 99.9% of the Solar System's mass. If you could stand on the surface of the Sun, you would weigh 28 times as much as you do on Earth because the Sun has more mass and therefore more gravitational pull than earth.

More than a million Earths could fit beneath the surface of the Sun. It doesn't look that big from Earth, though. That's because the Sun is so far away. Compared to other stars, the Sun is about average-sized. There are much bigger stars, and much smaller stars.

A very thin *solar wind* of gases blows from the Sun all the way to the edge of the Solar System. When it gets there, the gases mix with those coming from other stars.

What is the surface like?

There is really no actual surface on the Sun, but the whole sun is made out of gases, fire, and plasma. The gas becomes thinner as you go farther from the centre of the Sun, but there is no obvious edge. The part we see when we look at the Sun is called the photosphere, which means "ball of light". We call it the surface of the sun because that's where most of the light we see comes from. There is actually a lot of material from the Sun above the photosphere, and some of the gas is even blasted away to great distances.

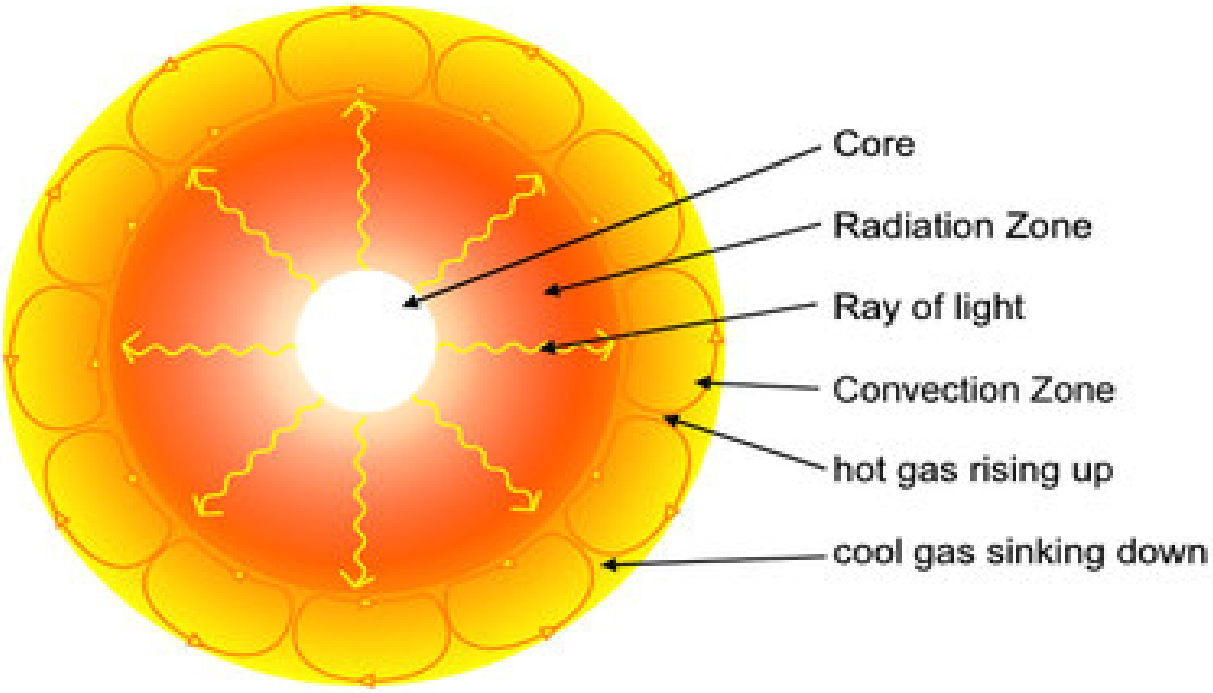
How does the sun make light and heat?

The Sun is the main source of energy for the Earth. This energy is made deep inside the Sun in a process called *nuclear fusion*. Four hydrogen **atoms** are fused together to make one helium atom. Some of the leftover matter turns into energy. This is the same way energy is released in a hydrogen bomb.

Core: The centre of the Sun is very dense. It's about 12 times as dense as lead. That means that a gallon of the gas from the core of the Sun would weigh half a ton. It's also very hot - about 15,000,000 °C. This region is where most of the nuclear reactions are taking place.

Radiative zone: In this zone the light and heat produced in the core fight their way out towards the surface. The gases that make up the zone are very dense and keep absorbing and emitting the rays. Have you ever tried to run through water? That's what it's like for light waves in this region of the Sun. Light can't go very far at all before it runs into something. Then it bounces off in a different direction. The light doesn't get very far this way. It can take a single ray of light a million years to get out of this zone.

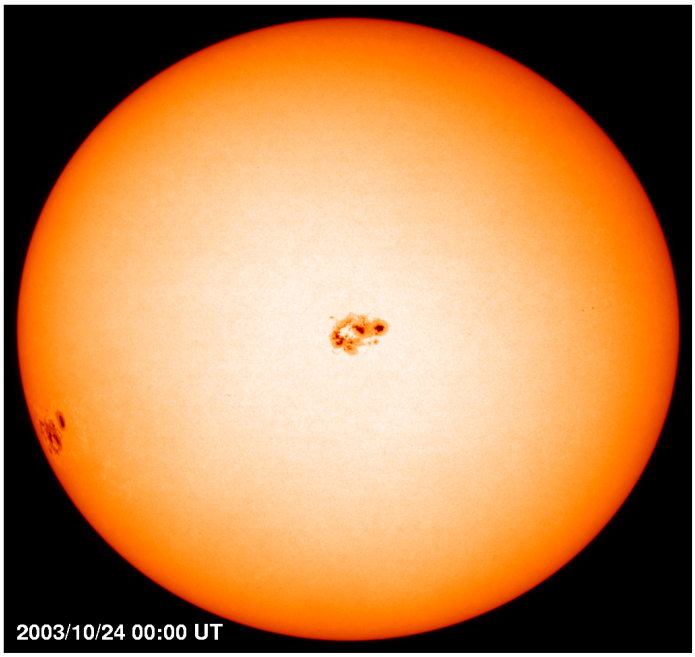
Convection zone: Have you ever seen the air shimmer above a fire? Perhaps you've been told it's because heat rises? Actually, it is the hot air that is rising. Hot gases get lighter and rise. Cold gases get heavier and sink. In this zone, the gases are less dense. They behave like air in a fireplace. Gas at the bottom of the zone gets heated up from below. It rises to the surface, gives off its heat to space, and sinks again. The gas in the convection zone forms currents like those in Earth's oceans and atmosphere. The currents are called *convection cells*.



What are Sunspots?

Sunspots are dark spots on the Sun, but they are still brighter than lightning. Sunspots look darker than the rest of the Sun because they are a little cooler. Even though sunspots are cooler than the rest of the Sun, they are still hot — about 4000 °C (7000 °F). Sunspots are caused by changes in the Sun's magnetic field. The magnetic field stops convection, which causes the sunspot areas to cool off and become darker. Sunspots usually form in groups which are carried around the Sun as it rotates.

The number of sunspots we see goes up and down every 11 years.

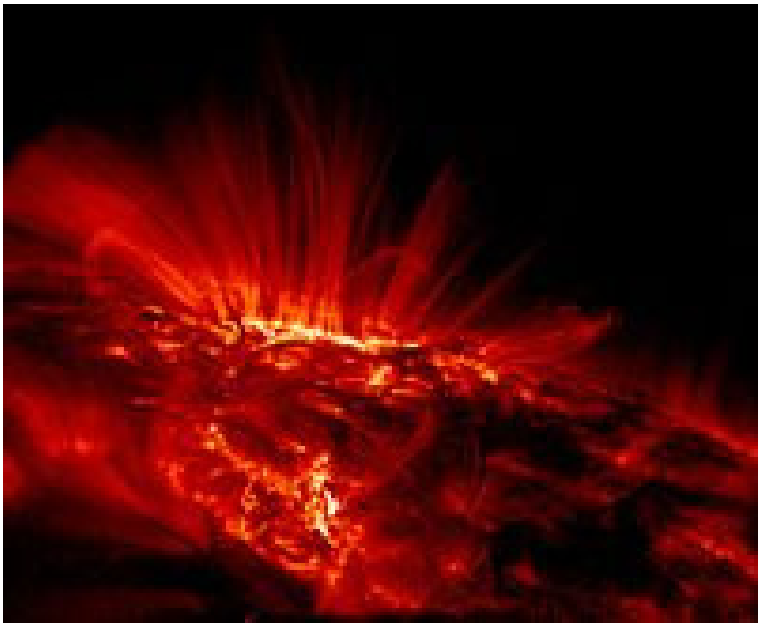


The dark areas are sunspots

What is the Solar Atmosphere like?

Above the photosphere, the Sun's gases are not very dense at all. There are two layers that we can see with special telescopes. Above that, gases stream out as *solar wind* that reaches to the edge of the Solar System.

A close-up view of a sunspot and prominences



Prominences and solar flares

If you have a telescope with special filters, you can see bumps around the edge of the Sun. Each one of these is called a *prominence*. They look like volcanoes erupting. They are hundreds or thousands of kilometres long. Some are bigger than the Earth. They often seem to come from sunspots. Sometimes they get so far away from the Sun that they fly away from it. Then they are called *solar flares*.

Chromosphere

Chromosphere means "colour ball". It is just above the photosphere. It is not as bright as the photosphere, and you can't normally see it. But you can see it just before a solar eclipse (only with special filters!). It looks like a flash of all the colours of light. Surprisingly, the Chromosphere is even hotter than the photosphere, at some parts over 20,000 °C.

Corona

The Sun's corona during an eclipse

Corona means crown. That is what pictures of the corona look like. It is just above the chromosphere. It is hotter than the photosphere, and it glows. It is made of thin gases, and blows away as solar wind. It shifts and changes, but it is hard to see, even with special telescopes.

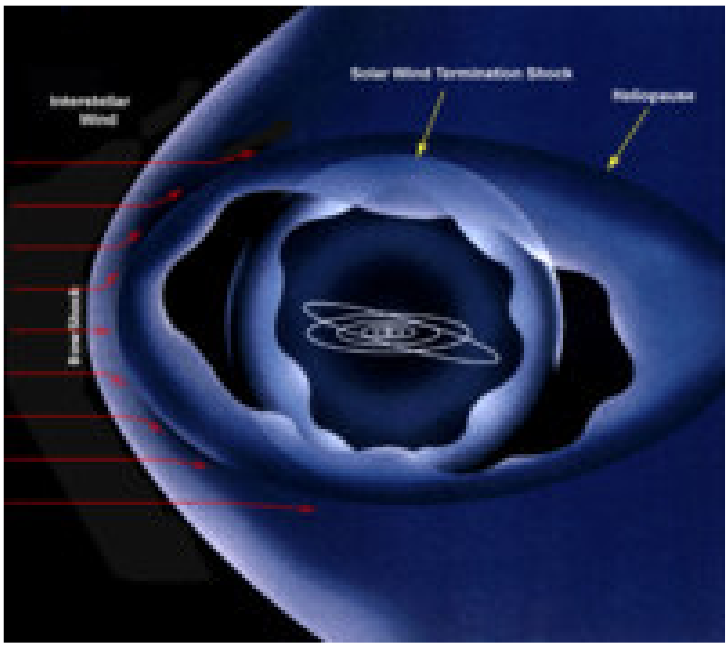
Solar wind

At the top of the corona, some of the gas blows out as solar wind. It blows fast — about 60 km per second (more than 100,000 miles per hour). But there isn't very much of it. The solar wind is strong enough to push dust and gas away from a comet to make a tail.

The solar wind can even push big things. In 1960, the satellite Echo I was put into orbit. It was a large balloon. Since it was so large and light, the solar wind pushed it around in its orbit. In the future, some space craft may use the solar wind to travel between planets using *solar sails* similar to the way sailboats use the Earth's wind in their sails to cross the ocean.

Heliopause

Heliopause: where the solar wind hits the edge of the Solar System



Heliopause is where the solar wind hits the wind from other stars. Near here, the solar wind slows down suddenly. In May 2005, the Voyager I spacecraft went through this region and felt a big bump. It is now just inside the heliopause. Because this happens so far from Earth, it is hard to study!

What is solar weather?

Did you know the Sun has weather? Earth weather is what is going on in Earth's atmosphere. *Solar weather* is what's going on in the Sun's atmosphere. Solar weather affects us on Earth. Solar weather (also called space weather) includes sunlight and the solar wind.

Solar flares shoot a lot of very hot gas out from the Sun. If a solar flare is aimed towards Earth, protons might be shot at Earth at high speed, and a *solar storm* could result. That could cause electrical blackouts or block radio signals. It could damage satellites in orbit. Radiation from a bad solar storm could be very dangerous for astronauts, so they must be protected. The Earth's magnetic field and atmosphere usually protect us from flares.

Solar flares can also cause an *aurora*. Auroras look like beautiful curtains of shimmering light. They are called Northern Lights (Aurora Borealis) if they are near the North Pole. They are called Southern Lights (Aurora Australis) if they are near the South Pole. Solar weather affects other planets, too. We have pictures of auroras on every planet except Mercury and Pluto.

Northern Lights

Just like we can get Earth weather forecasts, we can get Solar weather forecasts. Forecasters study the Sun to figure out when flares will happen. They try to tell when solar storms will hit Earth. They also try to tell when solar storms will go to other parts of the Solar System.

The life cycle of a star

A forming Sun's life starts out as a Nebula; this is a cloud of gas made up of hydrogen. Over time the nebula becomes more and more compact until it can burn hydrogen to helium, this becomes its power source. After this the star will look very much like our sun. They fuse hydrogen atoms together to make helium atoms. After Billions of years this star will die. The star will exhaust its supply of hydrogen in its core, there is no longer any source of heat to support the core against gravity, and the hydrogen starts to burn in a shell like formation around the sun, creating a red giant. This is all with an ordinary star and will be the life cycle of our sun, although the process may vary from star to star. When our sun becomes a red giant it will consume the earth. The sun will then begin to collapse again and the helium that is left will be condensed into carbon and burn for millions more years. After this the sun will be a red super giant and expand as far as Jupiter. Over time the star will cool and form a white dwarf, a small white speck of with the remnants of a solar system and our once massive star.

Sun to Nucleosynthesis