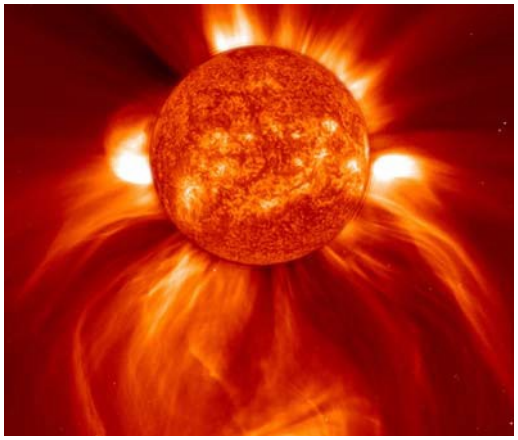
Sun Activity

The Sun provides the energy needed for life to exist on Earth. Every so often, sunspots and solar flares occur on the Sun's surface and can cause disruptions in our daily lives. From the invention of the telescope in the 17th Century to NASA's Nimbus-7 satellite, innovations have allowed us to gaze into space and study the sun and moon in amazing detail. The sun is constantly changing and we have been studying sunspots, solar flares and other solar phenomena for hundreds of years.



The sun emits radiation across the entire electromagnetic spectrum.

Visible: This part of the spectrum, which we can detect with our eyes, allows us to see and provides the energy for plants to produce food by photosynthesis.

Ultraviolet (UV): We cannot see this part of the spectrum, but it can damage unprotected skin, producing anything from a mild to severe burn to skin cancer.

Infrared: This part of the spectrum is made up of invisible rays that provide the heat that helps keep the Earth warm.

Charged Particles: The sun continuously emits energy and particles that make up the solar wind. When the charged particles interact with the Earth's magnetic field, particularly near the poles, the result is the aurora borealis, which is a spectacular display of color in the night sky.

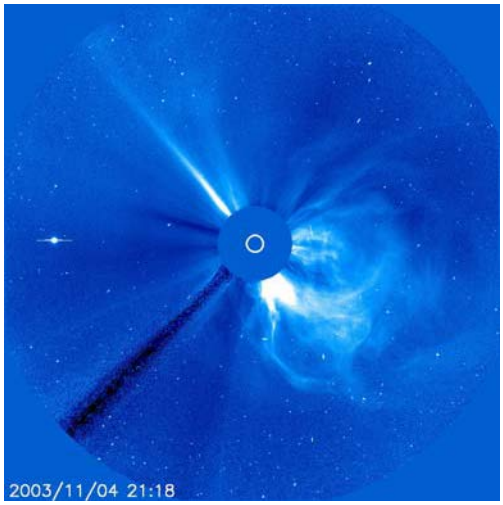
Sunspots - Sunspots are dark areas that form and disappear on the surface of the Sun over periods of days or weeks. Sunspots are caused by concentrated magnetic fields that reduce the amount of energy flow to the surface of the sun from its interior. The reduced energy flow causes the area to cool from about 10,800 ºF (the average temperature of the Sun's surface) to 7,600 ºF. Because sunspots are cooler than the rest of the Sun, they appear dark on the Sun's surface. Sunspots are so big that all of planet Earth would fit into a sunspot.

Solar Flares - Solar flares are the release, in a single burst, of energy in many forms - electro-magnetic (from radio waves through the visible spectrum to gamma rays and x-rays), energetic particles (protons and electrons), and matter that is so hot it is in the form of plasma. Flares are characterized by their brightness in x-rays. The National Oceanic and Atmospheric Administration monitors the x-rays from the Sun with detectors on some of its satellites. Observations for the last few days are available at NOAA's website, Today's Space Weather.

Flares are closely related to the cycles of the Sun's magnetic field, and they emerge from relatively cool, intensely magnetic regions of the solar surface - sunspots.

The energy released during a flare is typically ten million times greater than the energy released from a volcanic explosion. Even then, it only releases a fraction of the total energy emitted by the Sun every second. The radiation and radioactive particles released during solar flare activity can damage satellites and interrupt radio communications on Earth.

Coronal Mass Ejections (CMEs) - Coronal mass ejections are the sudden release of large masses of plasma from the very hot corona, which is the atmosphere just above the surface of the sun. CMEs expand away from the Sun at speeds as high as 4 million miles per hours! The light and x-rays accompanying a CME reach earth in a few minutes. The mass of particles may take three to five days to arrive. (The picture on the right, taken by the SOHO [Solar and Heliospheric Observatory] spacecraft, shows a CME. A small disk on the instrument blocks out the Sun itself so events in the Sun's atmosphere can be studied.)



Coronal mass ejections are more likely to have a significant effect on our activities than solar flares because they carry more material into a larger volume of interplanetary space, increasing the likelihood that they will interact with the Earth. CMEs typically drive shock waves that produce energetic particles that can be damaging to both electronic equipment and astronauts that venture outside the protection of the Earth's magnetic field.

Geomagnetic Storms - While a flare alone produces high-energy particles near the Sun, a CME can reach the Earth and disturb the Earth's magnetosphere, setting off a geomagnetic storm. Often, these storms produce surges in the power grid and static on the radio, and, if the waves of energetic particles are strong enough, they can overload power grids and drown out radio signals. This type of activity can also affect ground to air, ship to shore, and navigational communication, military detection, and early warning systems.

Observing the ejection of CMEs from the Sun provides an early warning of geomagnetic storms. Only recently, with SOHO, has it been possible to continuously observe the emission of CMEs from the Sun and determine if they are aimed at the Earth.

Potential Health Effects – Solar flares and coronal mass ejections result in the release of radiation across the spectrum, from x-rays to light waves to fast-moving protons to plasma. We know that satellites can be affected (even made non-functional) and astronauts need to be aware of the risk and seek shelter during these storms. Astronauts on the Space Station receive increased exposure during these solar phenomena. The energetic particles from a flare or CME would be dangerous to an astronaut on a mission to the Moon or Mars. As for sunspots, they are merely cooler regions of the sun and do not cause any particular harm.

Out of all of the Sun's activities, it is actually the Sun's UV rays that pose the greatest risk to human health.

Who is protecting you?

Federal Aviation Administration (FAA)

Commercial airlines' navigational equipment can be affected by solar activity causing data on the location of planes to be inaccurate. Fortunately, if navigators are alerted of the storm they can switch to a backup system that does not depend on vulnerable technology. The Federal Aviation Administration routinely receives alerts of solar flares so that they can anticipate communication and navigation problems and operate accordingly.

National Aeronautic and Space Administration (NASA)

NASA's Solar Particle Alert Network (SPAN) consists of multiple radio and optical telescopes that stream continuous data on solar flare activity. While solar flare eruptions are difficult to predict, instruments, such as those used in SPAN, can provide some warning as solar material makes its way from the Sun to the Earth. This information also allows astronauts, who receive more radiation exposure in space, to move to well shielded areas of their spacecraft.

U.S. National Oceanic and Atmospheric Administration (NOAA)

NOAA's Space Environment Center provides real-time monitoring and forecasting of solar and geophysical events, conducts research in solar-terrestrial physics, and develops techniques for forecasting solar and geophysical disturbances.

What you can do to protect yourself

UV rays pose a much greater risk to human health than the radiation from the Sun's other activities. Here are some of ways in which you can better protect yourself from the Sun's harmful UV rays:

- **Cover Up**: Wear tightly woven, loose-fitting, and full-length clothing.
- **Wear Sunglasses that Block 99-100% of UV Radiation**: Sunglasses that provide 99-100% UVA and UVB protection greatly reduce sun exposure that can lead to cataracts and other eye damage.
- **Always Use Sunscreen**: Apply a broad spectrum sunscreen with a Sun Protection Factor (SPF) of 15 or higher liberally on exposed skin. Reapply every 2 hours, or after working, swimming, playing, or exercising outdoors.
- **Watch for the UV Index**: The UV Index provides important information to help people plan outdoor activities in ways that prevent overexposure to the sun. This information is commonly found near weather predictions in newspapers and on the internet sites, like EPA's Sunwise UV Index site.

Resources

You can explore this radiation source further through the resources at the following URL:
http://www.epa.gov/radtown/sun-activity.html#resources

We link to these resources to maintain up-to-date information.