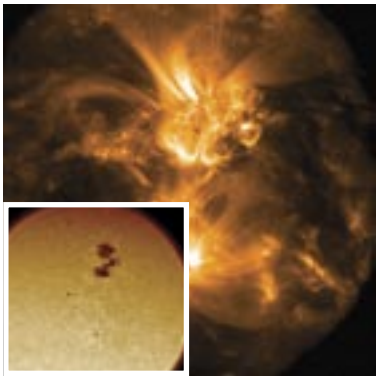
Sub-goal 3B: Understand the Sun and its effects on Earth and the solar system.



Large sunspots and their coronal structure observed by the Transition Region and Coronal Explorer (TRACE). Although sunspots can be observed by traditional telescopes from the ground, the solar corona can only be seen in extreme ultraviolet and X-ray wavelengths using instruments placed outside Earth's atmosphere. The million degree-hot bright coronal loops visible on the insert trace the magnetic field connecting two large sunspots and a cluster of pores. (Images: NASA)

Human life is linked to the behavior of the Sun, a star whose variability profoundly affects the viability of life on Earth. Changes in the Sun's long-term brightness cause ice ages, and the 11-year solar cycle of activity causes powerful flares and coronal mass ejections that impact Earth, disrupt telecommunications and navigation, threaten astronauts, damage satellites, and disable electric power grids. Research into the nature of solar activity and its effects on the solar system will help safeguard the journeys of robotic and human explorers.

Scientists are just beginning to understand the physics of the Sun–Earth connection. They have yet to understand the dynamo deep within the Sun, probe the intricate structures of its torrid atmosphere, and trace the complex responses of the solar system from the Sun to Earth. Such capabilities will provide insights into questions concerning how the system evolved, how it produced and sustains life, what will happen to this unique environment through the course of time, and how it will affect humankind.

As society becomes increasingly dependent on space-based technologies, humankind's vulnerability to space weather becomes more apparent, and the need to understand and mitigate these effects becomes more urgent. NASA's objective is to understand and predict the causes of space weather by studying the Sun, the heliosphere, and planetary environments as a single, connected system.

To achieve this objective, NASA will open the frontier to space weather prediction by studying and understanding the fundamental physical processes of the space environment—from the Sun to Earth, to other planets, and beyond to the interstellar medium.

The following series of new missions will refresh NASA's multi-satellite Sun–Solar System Connection Great Observatory and improve prediction of hazardous events wherever explorers travel.

- During 2006, NASA will launch the Solar Terrestrial Relations Observatory (STEREO) mission and, in partnership with Japan, will use the Solar–B spacecraft both to observe how magnetic fields on the Sun's surface interact with the Sun's outer atmosphere and to track the evolution of solar disturbances from the Sun's surface to Earth.
- In 2006, NASA will launch the Aeronomy of Ice in the Mesosphere (AIM) Small Explorer mission to help scientists understand how and why the highest altitude clouds in the Earth's atmosphere form.
- NASA will use the Time History of Events and Macroscale Interactions during Substorms (THEMIS) mission to discover the mechanisms responsible for the explosive release of solar wind energy within Earth's geospace.
- In 2008, NASA will launch the Solar Dynamics Observatory (SDO) to observe the solar interior and to determine the causes of solar variability.
- In 2011, NASA's Radiation Belt Storm Probes and Geospace-Related missions will determine how space plasmas are accelerated to hazardous energies to enable predictions of changes in planetary radiation environments to protect space explorers.
- By 2013, NASA plans to launch the Magnetospheric Multiscale Mission to observe the fundamental processes responsible for the transfer of energy from the solar wind to Earth's magnetosphere and for the explosive release of energy during solar flares.