

CHAPTER OVERVIEW

9: The Sun

“Space weather” may sound like a contradiction. How can there be weather in the vacuum of space? Yet space weather, which refers to changing conditions in space, is an active field of research and can have profound effects on Earth. We are all familiar with the ups and downs of weather on Earth, and how powerful storms can be devastating for people and vegetation. Although we are separated from the Sun by a large distance as well as by the vacuum of space, we now understand that great outbursts on the Sun (solar storms, in effect) can cause changes in the atmosphere and magnetic field of Earth, sometimes even causing serious problems on the ground. In this chapter, we will explore the nature of the Sun’s outer layers, the changing conditions and activity there, and the ways that the Sun affects Earth.

By studying the Sun, we also learn much that helps us understand stars in general. The Sun is, in astronomical terms, a rather ordinary star—not unusually hot or cold, old or young, large or small. Indeed, we are lucky that the Sun is typical. Just as studies of Earth help us understand observations of the more distant planets, so too does the Sun serve as a guide to astronomers in interpreting the messages contained in the light we receive from distant stars. As you will learn, the Sun is dynamic, continuously undergoing change, balancing the forces of nature to keep itself in equilibrium. In this chapter, we describe the components of the Sun, how it changes with time, and how those changes affect Earth.

- 9.1: The Structure and Composition of the Sun
- 9.2: The Solar Cycle
- 9.3: Solar Activity above the Photosphere
- 9.4: Space Weather
- 9.5: Sources of Sunshine- Thermal and Gravitational Energy
- 9.6: Mass, Energy, and the Theory of Relativity
- 9.7: The Solar Interior - Theory
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- 9.9: The Sun- A Garden-Variety Star (Exercises)
- 9.10: The Sun- A Nuclear Powerhouse (Exercises)

Thumbnail: The Sun—our local star—is quite average in many ways. However, that does not stop it from being a fascinating object to study. From solar flares and coronal mass ejections, like the one seen coming from the Sun in the top right of this image, the Sun is a highly dynamic body at the center of our solar system. This image combines two separate satellite pictures of the Sun—the inner one from the Solar Dynamics Observatory and the outer one from the Solar and Heliospheric Observatory. (credit: modification of work by ESA/NASA)

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