

LESSON 1: STAR POWER!

DISCOVERING THE POWER OF SUNLIGHT

LESSON OVERVIEW

LESSON SUMMARY

Students estimate the energy output of the Sun using a simple device and discover how much power sunlight provides to Earth; they learn that the Sun is the main source of energy on Earth. Students also evaluate the power of sunlight closer to the Sun—at the distance of Mercury. They also learn that sunlight and the electromagnetic spectrum are the main tools with which we study objects in the Solar System.

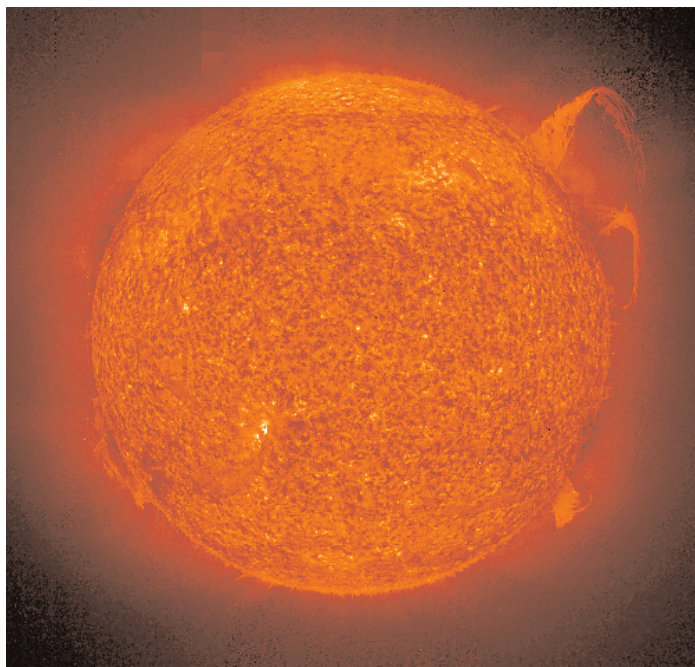


Figure 1. The Sun seen in extreme ultraviolet wavelengths. The surface of the Sun shows the granular structure of convective cells, while a few prominences erupt on the surface at the right-hand side of the picture. (Picture credit: NASA/SOHO; <http://sohowww.nascom.nasa.gov/bestofsoho/hooksG.gif>)

OBJECTIVES

Students will be able to:

- ▲ Build a simple device to measure the amount of energy carried by sunlight.
- ▲ Calculate the amount of energy arriving at the Earth from the Sun.
- ▲ Describe the difference in the amount of solar radiation at Mercury as compared with the Earth.

GRADE LEVEL
9 - 12

DURATION
About 2 hours

ESSENTIAL QUESTION

How much energy does sunlight provide to Earth and what is its role in Earth's energy resources?



CONCEPTS

- ▲ Radiation from the Sun is the main source of energy on Earth. It heats the Earth to a temperature at which life is sustainable.
- ▲ We can capture the energy from the sunlight and use it to do work on Earth.
- ▲ Solar radiation is important for studying objects in the Solar System.

MESSENGER MISSION CONNECTION

Sunlight is essential for the MESSENGER mission to Mercury. Many of the instruments study sunlight reflected off Mercury's surface or the infrared radiation emitted by Mercury's surface heated by sunlight. The properties of particle radiation from the Sun around Mercury is also investigated. But because Mercury receives up to 22 times as much sunlight as Earth's surface, mission designers have had to come up with ways to keep the spacecraft and its instruments from heating up significantly.

WARNING

Do *not* look directly at the Sun!

This lesson is about the Sun and sunlight, but be sure to remind students frequently ***never to look directly at the Sun!*** Looking for even a few seconds can cause permanent damage to the eyes, and longer exposure can cause blindness. Note that sunglasses do *not* provide an adequate safeguard against looking directly at the Sun.





STANDARDS & BENCHMARKS

NATIONAL SCIENCE EDUCATION STANDARDS

Standard B6 Interactions of energy and matter

- ▲ Electromagnetic waves result when a charged object is accelerated or decelerated. Electromagnetic waves include radio waves (the longest wavelength), microwaves, infrared radiation (radiant heat), visible light, ultraviolet radiation, x-rays, and gamma rays. The energy of electromagnetic waves is carried in packets whose magnitude is inversely proportional to the wavelength.

Standard D1 Energy in the earth system

- ▲ Earth systems have internal and external sources of energy, both of which create heat. The sun is the major external source of energy. Two primary sources of internal energy are the decay of radioactive isotopes and the gravitational energy from the earth's original formation.

Related Standards

Standard B5 Conservation of energy and increase in disorder

- ▲ Heat consists of random motion and the vibrations of atoms, molecules, and ions. The higher the temperature, the greater the atomic or molecular motion.
- ▲ Everything tends to become less organized and less orderly over time. Thus, in all energy transfers, the overall effect is that the energy is spread out uniformly. Examples are the transfer of energy from hotter to cooler objects by conduction, radiation, or convection and the warming of our surroundings when we burn fuels.

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Benchmark 4E3: Transformations of energy usually produce some energy in the form of heat, which spreads around by radiation or conduction into cooler places. Although just as much total energy remains, its being spread out more evenly means less can be done with it.

