

LESSON 2: DANGERS OF RADIATION EXPOSURE

LESSON OVERVIEW

LESSON SUMMARY

Radiation can affect living and mechanical things on Earth as well as in space. In the first part of the lesson, students calculate their yearly exposure rate to harmful high-energy radiation and cumulative effects over time, and use the information to evaluate the various sources of radiation that are of greatest concern for them. In the second part of the lesson, students learn that spacecraft and other objects in space must be concerned with the same kinds of radiation that humans are exposed to. The MESSENGER spacecraft will orbit Mercury and be subjected to much more intense solar radiation than it would near Earth. Students discuss the notion that even though some of the radiation is needed to study the properties of the planet, too much of it can be quite damaging.

GRADE LEVEL
9 - 12

DURATION
About 1 hour

ESSENTIAL QUESTION

What sources of high-energy radiation do we need to be concerned with in our daily lives?

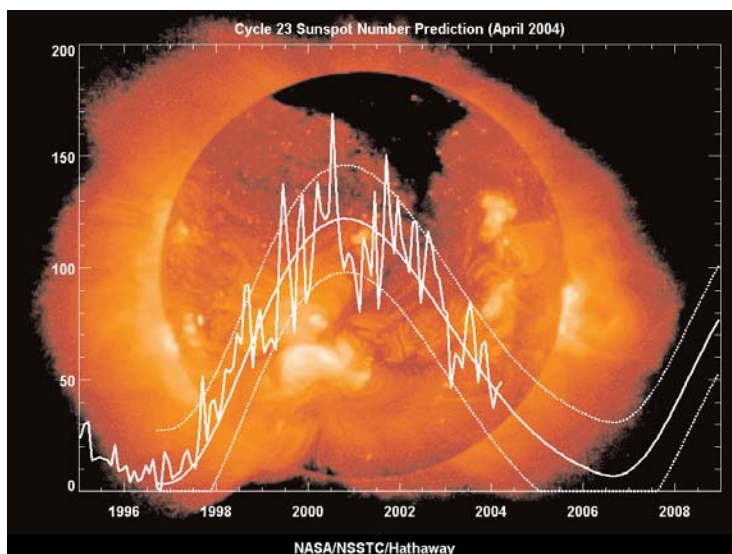


Figure 1. Solar activity cycle as followed by the number of sunspots on the surface of the Sun. The 11-year cycle has major effects on the radiation environment on Earth as well as for spacecraft venturing into the inner Solar System, such as the MESSENGER mission to Mercury.

Picture credit: http://science.nasa.gov/ssl/pad/solar/images/ssn_predict_1.gif

OBJECTIVES

Students will be able to:

- ▲ Calculate their annual exposure to high-energy radiation.
- ▲ Identify sources of high-energy radiation with which they may come into contact.
- ▲ Explain why the high-energy environment near Mercury is a concern for the MESSENGER mission.



CONCEPTS

- ▲ Radiation is a process of emitting energy in the form of particles or waves.
- ▲ Ionizing (high-energy) radiation is particularly dangerous because it can cause severe damage to humans. In sufficiently high doses, radiation can cause sickness and death.
- ▲ Most of the high-energy radiation to which humans are exposed comes from natural sources.
- ▲ Spacecraft need radiation of various kinds to observe objects in space but too much radiation can be a hazard.
- ▲ Understanding the causes and seriousness of risks can help engineers and scientists to reduce the likelihood of severe problems.

MESSENGER MISSION CONNECTION

MESSENGER will use radiation of various kinds to study the planet Mercury and its space environment. However, since Mercury receives up to 22 times the amount of radiation from the Sun that we receive on the surface of Earth, exposure to too much radiation is a concern for the mission.





STANDARDS & BENCHMARKS

NATIONAL SCIENCE EDUCATION STANDARDS

Standard F5 Natural and human-induced hazards

- ▲ Human activities can enhance potential for hazards. Acquisition of resources, urban growth, and waste disposal can accelerate rates of natural change.
- ▲ Natural and human-induced hazards present the need for humans to assess potential danger and risk. Many changes in the environment designed by humans bring benefits to society, as well as cause risks. Students should understand the costs and trade-offs of various hazards—ranging from those with minor risk to a few people to major catastrophes with major risk to many people. The scale of events and the accuracy with which scientists and engineers can (and cannot) predict events are important considerations.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, PROJECT 2061

Benchmark 10G5 Radioactivity has many uses other than generating energy, including in medicine, industry, and scientific research in many different fields.

Benchmark 1C6 Scientists can bring information, insights, and analytical skills to bear on matters of public concern. Acting in their area of expertise, scientists can help people understand the likely causes of events and estimate their possible effects...

