Lesson 4: Space Weather 1
Lesson 5: Space Weather 2
Lesson 6: Space Weather 3

Materials

Readings
Specialist Training
- Specialist Orientation

Space Weather
- Inside the Atom
- Here Comes the Sun
- Dr. Z: Inside the Sun
- Sheer Magnetism (PDF: an exploration)

Radiation Health
(homework: Lesson 7, 8)
- New Frontiers & New Dangers
- Radiation: Friend and Foe
- Do You Want the Recipe
- In the Kitchen with Poly
- Measuring Exposure to Radiation

Materials Preparation

Gather and organize the materials for Sheer Magnetism, Lesson 5 in Space Weather Unit. Prepare for Teacher Presentation / Discussion of electromagnetic spectrum, etc. during third lesson of Space Weather Unit

Unit Overview

This unit may be adapted to meet your curriculum standards. A number of concepts in the Space Weather articles may challenge your students. Fundamentals about the atom and electromagnetism form a common thread throughout. If you have taught these concepts, your students may simply focus on what is necessary for the mission.

Three points summarize what students need to know for the mission:
1) Space weather is a source of dangerous radiation. Coronal mass ejections (CMEs) spew solar plasma into space. Plasma consists of electrons, neutrons, protons (ionized hydrogen atoms), other sub-atomic particles, and ionized helium atoms (alpha particles).
2) An extreme form of CME is called a solar proton event (SPE). SPEs do not occur as frequently as CMEs and only during solar max. SPE's eject vast amounts of plasma (including solar protons) through space at various speeds, depending upon the velocity of the solar wind. Their arrival on earth takes between 30 minutes to 24 hours.
3) Space weather forecasters know when an SPE is imminent from increases in electromagnetic radiation in the form of X-rays and microwaves. An SPE emits a "spike" of X-rays. X-rays, travelling at the speed of light, go from the sun to the earth in 8 minutes. A sharp increase in X-ray activity precedes the arrival of radioactive solar plasma.

This unit covers fundamentals related to the atom and electromagnetism:
- The atom and the behavior of atomic particles link the main topics of e-Mission: Space Station Alpha. How the sun works, how radiation affects the human body, electricity, and how the space station's systems maintain a critical atmospheric balance are all related at the atomic level.
- Nuclear processes, the heat within the sun, and the sun's turbulent layers influence the creation and flux of magnetic fields and the unpredictable nature of solar weather.
- The earth's magnetic field, or magnetosphere, acts as a partial shield (along with the layers of the earth's atmosphere) to protect the earth and its inhabitants from the sun's dangerous radiation. Orbiting above the protection of the earth's atmosphere, the space station's systems and the astronauts are exposed to dangerous solar radiation and radioactive particles.
- Electromagnetism and the atom are intimately related.

Storyline

- The students begin their technical training as Mission Specialists. They begin by reading what it means to be a specialist (Specialist Orientation) and start Space Weather: Chapter One of the Specialist Training Manual.
- Mission Specialist training is a blend of scientific background information and an awareness of various technical aspects of the space station. The relationship between technology and science is emphasized throughout Mission Specialist training.

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Vocabulary
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Teaching Approaches
Lesson 4: Conduct a competitive (non-graded) quiz followed by student exploration of magnetism.
Lesson 5: Conclude exploration of magnetism and assign student groups an article to review and present.
Lesson 6: Conclude review of articles and conduct a wrap-up presentation/discussion of key concepts.

Connections to Other Units
An appreciation of the atom, atomic particles, and atomic processes will enhance Mission Specialists' understanding throughout the e-Mission experience. Electromagnetic radiation and atomic particles spewed from the sun during a solar storm affect everything they come in contact with at the atomic level: human cells, electrical systems, atmospheric conditions on the space station, etc.

Internet Resources:
Recommended search engines:
http://vivisimo.com
http://www.google.com
http://www.kartoo.com

Valuable Search Terms and Phrases: "Solar proton event," "atoms," "atomic particles," "atom particles," "space weather," "coronal mass ejection," "magnetosphere," "ionosphere." (Quotes and commas have been used here to delineate terms. Do not use quotes or commas when typing in a search term or phrase.)

Looking Ahead:
The Space Weather articles include a variety of dynamic illustrations. Several exceptional websites offer video segments of solar eruptions. The electromagnetic spectrum is wonderfully illustrated on a number of NASA websites.

You may want to conduct the third lesson in this Unit, which includes your presentation/discussion, in the school's computer lab to take advantage of these resources. The challenge this presents, of course, is maintaining student focus. Select an appropriate site that illustrates electromagnetism, use it as a presentation guide, and conduct your presentation from the back of the room.

For a highly structured presentation, try:
http://cse.ssl.berkeley.edu/lessons/indiv/nellie/new_nelli_student.html
and
http://imagine.gsfc.nasa.gov/docs/dict_ei.html#em_spectrum