

6.0 Education and Public Outreach Introduction

NASA's mission is to inspire the next generation of explorers. The Office of Space Science (OSS) has identified a specific enterprise goal to "share the excitement and knowledge generated by scientific discovery and improve science education", with specific objectives: (1) to share the excitement of space science discoveries with the public; (2) to enhance the quality of science, mathematics, and technology education, particularly at the precollege level; and (3) to help create our 21st century scientific and technical workforce.

OSS provides significant funding across the enterprise to support the achievement of these objectives. As a result of these investments over the past 5 years, EPO is now well integrated throughout all elements of the SEC theme. The Sun-Earth Education Forum and regional Broker/Facilitator institutions work together to develop and support partnerships between SEC scientists and education professionals in formal and informal settings as well as to encourage coordination of activities.

6.1 Sharing our Science with the Public

In the modern age, space exploration continues to thrill the public with new discoveries that help them build a better understanding of the Sun, near Earth space, the solar system, and the Universe. Whether encouraged through news releases highlighting solar events, high production value films bringing excitement of SEC science and research to life, PBS documentaries, innovative planetarium shows, museums, science centers, or rich website environments, a significant fraction of the US population retains an abiding fascination with space exploration and discovery that can be used to facilitate the achievement of the EPO objectives identified by OSS.



Sun-Earth Connection Education Forum

The Sun-Earth Connection Education Forum (SECEF) provides a national coordination and support structure for the SEC theme. A partnership between NASA's Goddard Space Flight Center and UC Berkeley's Space Sciences Laboratory, SECEF

- Facilitates the involvement of SEC scientists in education and outreach
- Helps identify high leverage opportunities
- Coordinates nationally and synthesizes the education and outreach programs undertaken by SEC flight missions and individual researchers
- Arranges for the widest possible dissemination and long-term sustainability of SEC education and outreach programs and products, and
- Identifies and disseminates best practices in education and public outreach.

The SEC Division has significant science resources to share with the public. However, sectors of the education and outreach community remain ill-prepared to take advantage of them. The large majority of K-12 educators are not prepared with sufficient science-based content knowledge to effectively develop students understanding and engagement with SEC related science themes. And yet, it is through the educational system that students are prepared for the workforce of tomorrow. Current demographic trends show that the US is facing a critical shortage of workers prepared with sufficient science, math, and technology knowledge to continue the technological leadership the US now enjoys, and which has also been responsible for the ability to dramatically expand SEC science knowledge over the past 50 years. It therefore becomes critical, for the health of the OSS enterprise and SEC science, to share science, enhance K-14 education, and assist in the development of our workforce.

6.2 Partnerships and Leverage

In order to achieve these objectives, the OSS EPO infrastructure is working to identify optimal ways to support the needs of multiple audiences – students, K-14 teachers, museum-based educators, community educators, the public, and policy makers. By targeting high leverage opportunities and partnerships, OSS SEC EPO activities can have a significant impact on large audiences that are difficult to reach through direct interactions alone. Resources and programs available from SEC can become integrated into ongoing programs through participation in and support of education initiatives and professional organizations, providing amplified impact. Professional development workshops for educators are a highly effective example of educational outreach. Results are particularly dramatic when educators are required to provide in-district training to their colleagues.



Innovative Partnerships

The National Parks provide a natural venue where the interests of the NASA Earth Science Enterprise, the Office of Space Science, and the National Park Service can complement and support each other in EPO efforts. Programs offered to the public by park rangers in these settings can be enriched by SEC science content. Examples range from supporting content on the aurora and noctilucent clouds for summer programs in Alaska to information about the Sun supporting educational programs at National Parks in the southwest.

High visibility for SEC EPO efforts is achieved by building on existing programs, institutions, and networks and by coordinating activities within NASA and other institutions. Promising opportunities for partnership exist with programs underway across NASA enterprises (for example, the NASA Space Grant Program and the Earth Science Enterprise Education Program), with programs under

development externally through funding from NASA and other agencies, foundations, non-profits, and industry. Through partnerships with educators and educational organizations, planetaria, museums, science centers, national parks, community groups, publishers and the media, SEC science can be shared through existing networks and infrastructures, developed by specialists in each of these EPO venues. In this way, the special strengths of the Division can be utilized – SEC science discovery, the excitement of SEC missions, and SEC scientists and engineers. Through these partnerships, and a careful analysis of existing resources, SEC EPO can avoid reinventing the wheel, and ensure EPO funds are invested for highest impact.

High Impact Video Programming

The “LIVE FROM” series, developed by Geoffrey Haines-Stiles’ Passport to Knowledge program, is a highly respected and high impact program supporting science education and literacy through broadcast media. With strong established relationships on PBS network stations, “LIVE FROM” EPO collaborations with this established program ensure a high visibility product that has been shown to have a positive impact on student learning. Successful programs include LIVE FROM THE HUBBLE SPACE TELESCOPE, LIVE FROM THE SUN, LIVE FROM A BLACK HOLE, LIVE FROM THE EDGE OF SPACE AND TIME, MARS 2002. In 2003, LIVE FROM THE AURORA is planned to highlight Sun-Earth Connections science through the beauty and dynamics of Earth’s aurora.



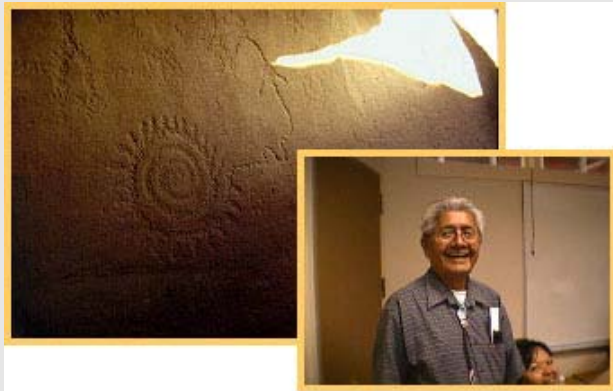
6.3 EPO Highlights - Examples of Successful Programs

There are now numerous examples of successful EPO products and programs highlighting SEC science and discovery. Over the past 3 years, SECEF has focused on development of resources for K-12 and informal education, including curriculum guides, educational materials, and workshops for educators, exhibits, planetarium shows, and the SEC web portal. In addition, SECEF has played a major role in facilitating organization and programming for events associated with solar eclipses and Sun-Earth Day.

In addition to these activities, SECEF has been active providing infrastructure support to EPO activities within OSS, including supporting development of the Space Science Education Resource Directory, facilitation of space science product and website review, as well as support of national conferences.

Sun-Earth Days

During Sun-Earth Day, 2001 (April 27-28), over 100 events were scheduled nationally, involving 200,000 formal education participants. All NASA education offices were involved in workshops, special events, classroom visits, and other dissemination opportunities. Sun-Earth Day, 2002 (March 20) combined a Native American connection and equinox theme for a multifaceted successful event. Resources included grade-level appropriate classroom activities, a central website, a Sun-Earth Day kit distributed through NASA Core, and a NASA Quest webcast with scientists and featured activities.



EPO efforts for future missions should build upon this heritage, and identify new opportunities to share the excitement and relevance of our science to society, with educators, students and the public.

High Impact Web Portals

Web sites developed over the past several years with funding from NASA and other agencies provide high leverage venues for further education and outreach efforts, due to their large existing audiences and content bases. The award-winning Windows to the Universe project, now in its 8th year of development, serves over 4 million users per year, and is used extensively in the K-12 classroom by students and teachers. Supported primarily through the OSS Information Technology Research Program in partnership with the Earth Science Enterprise, this existing high-leverage web resource is now being used to support new OSS missions and research programs.



6.4 EPO Themes for the Future

Missions in the near- and intermediate-term across the STP and LWS lines share several common thematic elements for the purposes of education and public outreach – magnetic fields, plasmas, the Sun and its impact on the near Earth space environment. For these audiences, the details of the physics explored in each mission are likely to be beyond the scope of understanding for most people. The common themes identified here, however, are highly relevant to both the public as well as to students and educators, invite their curiosity and provide vehicles for showcasing exciting scientific discovery at the forefront of mission research.

All SEC missions share an emphasis on space plasmas and the role of magnetic fields. From the perspective of the public, students, and educators, near-term missions (Stereo, Solar B, and SDO) and intermediate-term missions (Telemachus, Solar Orbiter, RAM, Solar Probe, and Inner Heliospheric Sentinels) will highlight the Sun, phenomena on the Sun, their variability, and their impact on the inner heliosphere. MMS, GEC, MagCon, Radiation Belt Storm Probe, Ionosphere Thermosphere Storm Probe, Inner Magnetospheric Constellation, and Tropospheric ITM Coupler focus on the detailed structure and dynamics of planetary magnetospheres and plasmas, in the case of GEC and Tropical ITM Coupler extending to the coupling of the magnetosphere with the ionosphere and atmosphere of Earth. Similarly, although JPO targets the Jovian magnetosphere/ionosphere system, the fundamental processes involved mirror those under investigation with the Earth magnetosphere/ionosphere focused missions mentioned above. For the purposes of EPO, the potential to compare and contrast results from JPO with MMS, GEC, and Magnetospheric Constellation is very powerful.

The high impact themes described below are recommended as those that will be particularly fruitful for EPO activities, based on their cross-cutting nature and relevance to educational needs. Each supports multiple missions described in the Roadmap, has strong links to the NSES, and have significant potential for high public impact due to the inherent nature of the theme and the quality of imagery available.



High Impact EPO Themes

Voyage to a Star – A focus on missions to the Sun will highlight science in extreme environments. EPO activities connecting to this theme will support multiple missions described in this Roadmap document and connect strongly with content standards described in the NSES. Solar and celestial events can be used as the focus of high impact public events that can delve further into the science.

Magnetic Fields – Magnetic fields are central to SEC research and numerous missions described in the Roadmap. The invisible nature of this force, acting at a distance, is inherently fascinating to young people, yet also is poorly understood by educators and the public. In addition, magnetism appears prominently in the NSES.

Solar Variability – Variability of the Sun on different temporal scales in the past, present, and the future has particular relevance to the public. Whether focusing on solar eruptive events or the Maunder Minimum, the variability of the Sun and its potential impact on the Earth’s environment connects directly with society. With strong connections to the NSES and linkages to climate, this is a topic of high societal relevance and public interest.

Space Debris – Public interest and concern about space debris can be used to provide educational resources on gravity, variable atmospheric effects (drag) related to space weather effects, and satellite orbits and tracking. This topic has strong links to the NSES, and there is the possibility of events associated with incoming debris.

Voyage to the Unknown – Continuing trek of Voyager and Pioneer to the edges of the solar system is a fascinating concept for students and the public. This provides a window to outer heliospheric topics, and has connections to the NSES.

6.5 EPO Program Elements for Future Emphasis

The lack of diversity in the professional scientific workforce has recently been recognized as a critical national issue for the future of science. In the face of imminent large-scale retirements at high levels across industry, federal agencies, and academia in science, declining numbers of the

“traditional” scientific workforce is pursuing scientific careers. Although some fields have had moderate success attracting minorities and women to fill this gap, the geosciences lag behind all other fields of science in recruitment of underrepresented scientists. EPO efforts developed through SEC can contribute to the objective of attracting underrepresented students to our field through examination of existing programs and best practices. Opportunities range from working in collaboration with after-school programs for K-12 students, supporting outreach programs at museums in urban settings, working with schools in inner city settings, to providing enrichment to academic bridging programs at institutions such as community colleges and Minority Serving Institutions.

Additional opportunities to bring our science to students in K-14 settings arise when we use our science in examples of mathematical, geographic, historical, and social contexts. Likewise, our science is rich in examples of complex systems, processes, and models that can be used to address NSES requirements to develop student understandings of unifying concepts and processes. Another rich area for EPO development is technology and engineering. SEC missions provide exciting examples of complex technologies and amazing engineering concepts that can excite students through research/design experience.

Connecting Sun City with Sun-Earth Connections Minority Partnership

Through a mix of school-year and summer activities, "Connecting Sun City with Sun-Earth Connections" will encourage El Paso-area Hispanic students to pursue science careers and assist teachers and university faculty in providing improved science education to their students by using space science as a thematic vehicle to create enthusiasm for science and mathematics. University of Texas at El Paso (UTEP) faculty in all departments of the College of Science will participate in the program in conjunction with teachers from area schools. Activities include summer inquiry institutes for teachers, shorter school-year workshops, and school visits for teachers as well as summer science camps for students.

