The High-Energy Astrophysics Learning Center—and More!

L. A. Whitlock
NASA-GSFC and USRA, Code 660.2, Greenbelt, MD 20771

Abstract As part of the education outreach efforts at NASA-Goddard's HEASARC (High Energy Astrophysics Science Archive Research Center), we have developed two World Wide Web sites for astronomy and space science education. "StarChild" is a site geared for ages 4–14, and the "High-Energy Astrophysics Learning Center" focuses on ages 14-adult. In both sites, information is presented on a variety of reading and comprehension levels. Interactive activities, movies, and animations are included.

The sites have been developed with the participation of, and review by, teachers of all grade levels. The sites are now also being distributed in a CD-ROM format. Development of the sites and our future plans are discussed.

1. Introduction

The "High-Energy Astrophysics Learning Center" site on the World Wide Web is a collection of pages presenting information about X-ray and gamma-ray astronomy to a wide variety of ages and education levels. At present, the information is for ages 14 and up. Included is a Teacher's Corner which contains lesson plans for teaching everything from pre-algebra to advanced chemistry using astronomy data and astronomical concepts. These lesson plans have been developed for us by teachers and tested in their classrooms. Our second site, "StarChild," contains information and activities about general astronomy and space exploration geared for ages 4–14. All of the materials were written for us by teachers. A detailed paper about "StarChild" appears elsewhere in this volume (Truelove and Dejoie 2006), so it will not be discussed further here.

It is firmly believed that X-ray and gamma-ray astronomy can and should be taught in the classroom. It has not been taught previously only because the fields are so young (achieving significance only in the 1970s). However, what we learn about our Universe in these regions of the electromagnetic spectrum is unique, exciting, and will become more and more commonplace in the 21st century. We need only take the time to explain our subject, both to the education community and to the general public, in order for them to get as excited about it as we are. Given this, one of our guiding principles has been a strict requirement for educator involvement. This was, and remains, crucial in assuring that the product we generate is useful in the classroom as well as accessible to casual web browsers. It is often quite difficult for professional scientists to discern if they are communicating effectively with the general public about their scientific pursuits. Thus, we put together a network of educators to provide us with regular feedback about our materials. These educators come from Maryland, Georgia, Florida, Virginia, Alabama, and Vermont; they

represent a broad range not just geographically, but also in computer resources and literacy. They provide us with invaluable advice in the development of the Learning Center. We have also been attending conferences since December 1996 to interact directly with even larger groups of educators from all over the world, not only to let them know about our efforts, but to get responses from them about their likes, dislikes, needs, and requirements.

The Learning Center was developed primarily through the efforts of volunteers. The programmers, the scientists, and the teachers involved in the project have given generously of their time and talents because they believe in the spirit of the project, namely, to present exciting and challenging new material to the public at large and to young people in particular.

2. Brief description of the Learning Center

There are ten icons which allow users to navigate around the web site. They are:

• "Learning Center"—always returns the user to the homepage where one will find "What's New at the Learning Center," "News Flash!," and "Ask a High-Energy Astronomer." The "News Flash!" is a series of articles written in a newspaper format recounting some of the latest discoveries and happenings in the ever-changing field of high-energy astronomy. The "Ask a High-Energy Astronomer" service allows users to email questions about science for response by a group of Ph.D. scientists.

• "High-Energy Village"—an alternative path for exploring our site, the "Village" is a more graphics-driven way to access all of the information in the site from a single, selectable image.

• "Introduction"—written for ages 14–16, this section provides information on the electromagnetic (EM) spectrum and what is learned by observing an object in different regions of the spectrum.

• "Basic High-Energy Astrophysics"—written for ages 15–17, this section provides additional information about the EM spectrum; a description of light curves, images, and spectra as tools for astronomers; and a wide-ranging discussion of X-ray and gamma-ray topics—from history to targets such as black holes, neutron stars, supernovae, and more.

• "Advanced High-Energy Astrophysics"—written for ages 17 and up, this section presents a more advanced, technical (but still non-professional astronomer) level description of similar topics as found in the Basic Level.

• "High-Energy Astrophysics Satellites"—includes information about every X-ray and gamma-ray astronomy mission flown which provided data (intentionally or not!) to cosmic X-ray or gamma-ray astronomers.

- "High-Energy Astrophysics Data and Software"—presents an introduction to the available X-ray and gamma-ray data archives, as well as descriptions and examples of the basic data analysis tools.
- "Other Learning Centers"—links to other World Wide Web sites which we have found to be excellent education sites on a wide variety of astronomy- and space science-related topics.
- "Dictionary"—a glossary of physics and astronomy terms which may be helpful in understanding our site and its topics.
- "Teacher's Corner"—a section containing information about astronomy and space science resources for teachers; study guides which teachers can use with their students in exploring our sites; and lesson plans developed for mathematics, physics, and chemistry classes which use actual high-energy satellite data. These lesson plans are designed for use both with and without classroom web access.

3. Usage

The "High-Energy Astrophysics Learning Center" went on-line in May 1996. Since then, use of the site has been steadily growing, with a large sustained spurt when the major search engines finally found us. By May 1997, we had over 68,000 non-developer accesses per month. Of these users, 18.5% have the ".edu" address representative of United States educational institutions, and 8.5% carry a non-US extension.

4. Future developments

The "High-Energy Astrophysics Learning Center" is about to change its name and enlarge its focus. During the first twelve months of our existence on the web, we have grown and changed. We think it is time to "present a new look" which better represents the fact that we have more than just information about the wonders of the high-energy universe available for our visitors. We have information about the electromagnetic spectrum, lesson plans for math and chemistry, movies about Kepler's Laws and comets—and, of course, "StarChild."

The Learning Center site will soon become "Imagine the Universe!" and will be located at http://imagine.gsfc.nasa.gov/. The new site will be devoted to explaining how scientists probe the structure and evolution of our Universe. It will discuss all of the tools which scientists bring to bear on understanding how objects (such as neutron stars, quasars, etc.) came into being, how they evolve, and what, in the end, will become of them. All of the information now found in the Learning Center will be included in the new site, along with many new topics such as radio, microwave, and far-infrared discoveries and technologies. We will also greatly expand our list

of other resources which users, especially teachers, might find useful—including magazine articles, videos, slide sets, and books which have good discussions related to our topics.

New CD-ROM versions of our web sites will continue to be released every spring, so that educators and students without web access can continue to have updated versions of our information. Furthermore, a series of posters with accompanying activity booklets began in late 1997. Each year, a new topic will be chosen which reflects some exciting object or topic in our Universe. The first poster is on the "Life Cycle of Stars"; the second will be on "Black Holes." The posters and booklets will come in two varieties: one for the "StarChild" level, and one for the high school level. The posters, booklets, and CD-ROMs will be distributed at no cost to educators.

Reference

Truelove, E., and Dejoie, J. 2006, *J. Amer. Assoc. Var. Star Obs.*, **35**, 277.