

Education and public outreach initiatives from the National Aeronautics and Space Administration

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Abstract. From the dawn of consciousness, humans have looked up and wondered about what the universe holds. It is that sense of wonder and thirst for knowledge that astronomy has helped fuel. In this paper we look at how education and public outreach has been a major element in preparing the next generation of astronomers and in sharing with the public the excitement of discoveries we make when we explore the Universe. The National Aeronautics and Space Administration (NASA) has a clear set of goals and objectives related to education and public outreach. These goals follow directly from NASA's mission "to inspire the next generation of explorers". Making progress towards achieving these goals has become an important part of the broad justification for public support of space science. Here we will describe a number of education and public outreach initiatives that are examples of the plethora of NASA funded programs and resources.

Keywords. Education, formal education, informal education, public outreach, NASA, discovery, exploration, HST, Spitzer

1. Introduction

The National Aeronautics and Space Administration (NASA) strategic plan presents a clear set of goals and objectives related to Education and Public Outreach (E/PO). These goals follow directly from NASA's mission "to inspire the next generation of explorers" and seek to:

- Share the excitement of space science discoveries with the public;
- Enhance the quality of Science, Technology, Engineering and Mathematics education, particularly at the pre-college level;
- Help create our 21st century scientific and technical workforce.

For over a decade, many NASA missions have adopted those goals as the backbone of their education program. All aspects of any NASA E/PO plan are mapped to them, and are relevant and supportive of NASA's educational philosophy. Addressing these three goals has led to the establishment of a multi-faceted portfolio of activities involving many types of partners and carried out in many types of communities across the United States of America. The NASA E/PO initiatives fall into three key programmatic areas: formal education, informal education, and public outreach. These initiatives are critical to the program's ability to deliver a successful and innovative education and outreach program and to achieve compliance with its vision and goals.

2. Formal education initiatives – students and educators programs

2.1. *Teacher and student research experiences: Spitzer teachers observing program*

The Director's Office of the Spitzer Science Center (SSC) allocated some of the Spitzer Space Telescope observational time for E/PO purposes. With this in mind, the SSC E/PO office and the National Optical Astronomy Observatory (NOAO) designed a program for teachers and students using the Spitzer Space Telescope. This program allows a group of teachers and their students to team with Spitzer and NOAO scientists and utilise the available observing time for an educational research experience.

The participating teachers first attend a workshop to become familiar with the Spitzer Space Telescope archives, and to receive training in infrared astronomy and observational techniques. The teachers also attend a second workshop to learn about the observation planning process, and telescope and instrument capabilities.

The selected teachers are divided into teams and expected to be active and develop competency in the major aspects of carrying out a science investigation including planning, target selection, and data analysis and interpretation. Once the proposals submitted to and accepted by the SSC Director, the observations and data analysis begin. At the end, the teachers and their students present results during various scientific and educational conferences.

After this experience teachers become ambassadors not only for the Spitzer Space Telescope but also more importantly, for astronomy and space science. The selected teachers are expected to promote a broader educational program that will involve other schools and a public outreach program that will extend to their larger community.

Each Spitzer teacher is expected to give 3 half-day professional development workshops in their district, or neighbouring school districts before the Spitzer observations are made, and at least 3 talks on the project at the state, regional, or national teacher conferences after the observations are made. The workshops focus on teaching infrared astronomy and utilise NASA provided infrared teaching kits.

2.2. *Teacher workshops*

In addition to full research experiences, NASA missions also provide teachers with shorter, but still significant educational training experiences that can be used as continuing education credits. To this end, "short courses" are offered at all meetings of the National Science Teachers Association (NSTA), both national and regional.

3. Informal education initiatives

Teachers and museum staff observe that space science sparks children's interest more than any other scientific subject, with the possible exceptions of robots and dinosaurs. With this in mind, NASA has created a plethora of Museum exhibits and planetarium shows that proved to be favorites with the public young and the young at heart, kids and their parents, and students and their teachers.

3.1. *"From Earth to the Universe" international exhibit*

"From Earth to the Universe" (FETTU) is a collection of astronomical images that showcase the most dramatic views of our Universe. The images represent the incredible variety of astronomical objects that are known to exist –planets, comets, stars, nebulae, galaxies and the clusters in which they congregate– and is being exhibited in over 250 locations throughout the world in 2009 and 2010. These exhibits, held in public parks,

airports, art centers and at other unique sites, bring the wonders of the universe right to the public.

3.2. “Visions of the Universe Libraries” travelling exhibit

In turning his telescope to the heavens in 1609, Galileo embarked upon a journey that would revolutionise science and culture, profoundly altering our view of our place in the universe. Our changing views of the universe are portrayed in the images and text of this travelling exhibit, for libraries, “*Visions of the Universe: Four Centuries of Discovery*”.

The exhibit sponsors were specially interested in receiving applications from public libraries in small towns and rural areas that have limited access to NASA resources. The exhibit includes twelve panels that feature key astronomical discoveries from the past 400 years. The exhibit also highlights the technological advancements that made these discoveries possible. Exhibit topics range from celestial objects within our own ‘cosmic backyard’: the Sun, the Moon, Mars, and Saturn to those beyond the realm of our solar system – including comets, stars, nebulae, and galaxies.

4. Public outreach initiatives : “Touch the Invisible Sky”

The book *Touch the Invisible Sky: A NASA Multi-wavelength Book* is a unique project in which images from several different wavelengths are, for the first time, published and distributed to the blind and visually-impaired community.

This book’s goal is to introduce the world of multi-wavelength astronomy and a multi-wavelength Universe to a group of the population that has historically been underserved. It proposes to raise their awareness and understanding of astrophysics by publishing a book of tactile graphics.

The book combines Braille, large type print, and tactile images so visually impaired people can ‘feel’ the images of astronomical objects observed in several different wavelengths. They will perceive the universe from an entirely new perspective, the same way “*Touch the Universe*” introduced Hubble Space Telescope images. The first book focused on planets and nearby star clusters – the “*Touch the Invisible Sky*” book delivers objects in the Universe that are hidden to our eyes.

5. Conclusion

Today’s scientists and engineers are the current generation of Space Explorers and have a unique opportunity to impact scientific and technological literacy and “*to inspire the next generation of explorers*”.

The most important asset of any NASA mission is the people working on it. Every NASA mission has an outstanding group of scientists and engineers available to assist in public and educational events. The E/PO groups continue to involve and engage the science and engineering communities of their mission in all aspects of its education and outreach programs as well as to provide them with support in their own education and public outreach initiatives.

In this paper we have discussed few examples that show how a NASA mission is involving the public as well as teachers and students in science with multi-disciplinary educational resources produced with the goal of engaging the young minds of future generations of scientists. The continuous positive response of the public has been an absolute motivation to create new and innovative methods to reach them. The NASA Education and Public Outreach community is a dynamic group that has made its vocation to revive the interest, to excite the dreams, and hopefully to answer some of the questions and satiate the public thirst for knowledge of space and science.