

Exploring the Invisible Universe: A Tactile and Braille Exhibit of Astronomical Images

Kimberly Kowal Arcand
Chandra X-ray Center/SAO
E-mail: kkowal@cfa.harvard.edu

Megan Watzke
Chandra X-ray Center/SAO
E-mail: mwatzke@cfa.harvard.edu

Chris De Pree
Agnes Scott College
E-mail: cdepree@agnesscott.edu

Key Words

Public Outreach
General
Astronomy
Materials for the Visually Impaired
Braille
Tactile

Summary

A tactile/Braille exhibit for the visually impaired community in the USA was launched in July 2009. The exhibit is part of the global From Earth to the Universe (FETTU) project, a Cornerstone of the International Year of Astronomy 2009. The science content of the travelling tactile/Braille exhibit includes explanations of our Sun, Eta Carinae, the Crab Nebula, the Whirlpool Galaxy and the electromagnetic spectrum, and was adapted from the tactile/Braille book *Touch the Invisible Sky*. We present some of the early observations and findings on the tactile/Braille FETTU exhibit. The new exhibit opens a wider door to experiencing and understanding astronomy for the underserved visually impaired population.

Introduction

Astronomy is considered by many to be one of the most visual of the sciences. Many people have some experience with visually processing and reacting to astronomical information, beginning with gazing at the night sky. Today, however, astronomy and astrophysics extend far beyond what is detectable with the human eye. Researchers explore the Universe through a modern “tool kit” of space-borne telescopes and ground-based observatories that cover the entire electromagnetic spectrum. It is the combination of these different types of light — from high energy X-rays and gamma rays to low energy microwaves and radio waves — that has enabled numerous exciting discoveries. Without multi-wavelength astronomy that includes “invisible” light, we would know much less about such exotic cosmic phenomena as black holes, plan-

etary formation, galaxy growth and even the Big Bang.

Astronomy is now simultaneously a visual science that must also be communicated in ways that include information about non-visual phenomena. It is this inherent duality in modern astronomy that positions the subject matter uniquely to serve both the sighted and non-sighted communities. Astronomy can capitalise on how the Universe is studied in non-visual ways to help various audiences in the general public engage in and interpret the wondrous discoveries of the cosmos.

Background

The From Earth to the Universe (FETTU) project is an exhibition of astronomical images that showcases the most dramatic

views of our Universe, bringing the science of astronomy to a diverse and worldwide audience. The images, which represent the incredible variety of astronomical objects that are known to exist, are being exhibited in over 850 locations throughout the world in 2009 and 2010 as part of the International Year of Astronomy 2009. In the United States, over 40 FETTU exhibits (approximately half of which are funded by NASA) are occurring in non-traditional astronomy outreach locations such as airports, libraries, parks and college campus greens. The goal of the FETTU project — run by the Chandra X-ray Center (CXC) — has been to engage the largest number of people possible. In July 2009, a NASA-funded tactile and Braille exhibit was launched for the visually impaired community as part of the FETTU programme. We present some of the early observations and findings on the tactile/Braille FETTU exhibit.

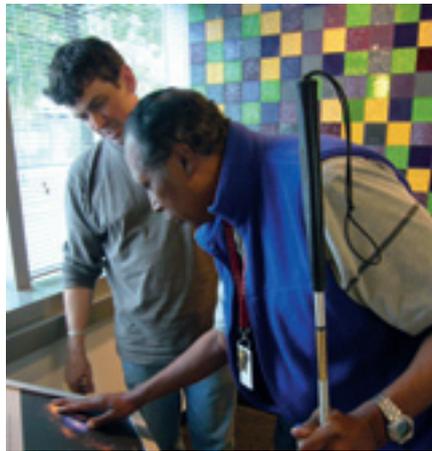
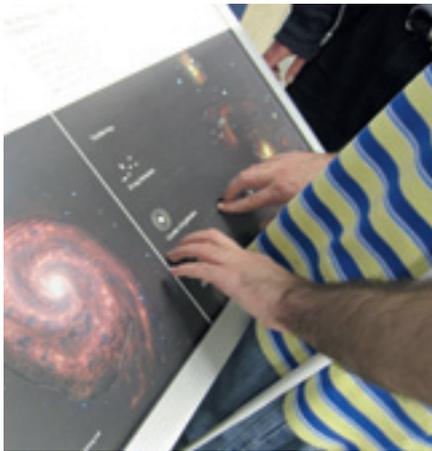


Figure 1. Left: The tactile exhibit in Washington, DC. Credit: James Timony. Middle: Professor Chris DePree (left) of Agnes Scott College, discusses an exhibit image with Lafayette Wood (right), former Center for the Visually Impaired (CVI) client and member of the CVI Alumni Club. Right: CVI staff member and current CVI youth at the tactile exhibit in Atlanta. Credit: Liz Hayes.

Exhibit design and dissemination

The science content of the tactile and Braille exhibit includes explanations of the Sun, Eta Carinae, the Crab Nebula, the Whirlpool Galaxy and the electromagnetic spectrum. There are four 45 cm x 90 cm tilted four-legged aluminium stands (each about 95 cm high), built to Las Vegas safety standards. The “desktop faces” of the exhibit stands consist of large-print text underneath a complete overlay of Braille for the image captions and keys, as well as specially developed textures for the images (Figures 1 and 2). Four copies of this tactile/Braille exhibit were produced, as the printing technology used to create it requires multiple print runs of the tactile process¹. The tactile/Braille content of this exhibit was adapted from the NASA-funded tactile/Braille book *Touch the Invisible Sky* written by Noreen Grice, Doris Daou and Simon Steel, and published by Ozone Publishing Corp. Methodologies and material that had been pilot-tested at the National Federation for the Blind Summer Science camp and at the hands-on stations at the book launch were adapted by Steel to develop accompanying educational activities for

the visually impaired community and informal education providers. These activities present fundamental concepts of modern astronomy designed to put the FETTU images into a broader context of how the Universe is structured and evolves.

Multiple geographic locations and venue types were targeted for the tactile/Braille displays, including public spaces that specialise in handicapped materials, schools for the blind, as well as the same public locations that the full-size, travelling FETTU exhibit reaches (Figure 3). The first tactile exhibit was displayed on 18 July 2009 at the Martin Luther King Jr. library, the main branch of the DC Public Library (Figure 1). The tactile/Braille FETTU exhibits have also been displayed at Yerkes Observatory (Williams Bay, Wisconsin), the Center for Science and Industry (COSI; Columbus, Ohio), the Atlanta Center for the Visually Impaired (CVI; Atlanta, Georgia), the UMass–Boston campus, the Perkins School for the Blind (Boston, Massachusetts), the University of Arkansas at Fayetteville, the Interamerican University at Bayamón (Bayamón, Puerto Rico), as well as the Eugene Francis Hall of the University of Puerto Rico, Mayagüez Campus (Mayagüez, Puerto Rico).

For each of the exhibit locations, supplementary content is provided to the community, including copies of the *Touch the Invisible Sky* Braille book, audio podcasts of the material from the book and the set of educational activities.

Location: Perkins School for the Blind, Watertown–Boston, Massachusetts

The Perkins School for the Blind hosted the tactile/Braille FETTU exhibit from October through December 2009. This exhibit was placed in the lobby of the Howe building, a towered stone structure that houses the school’s museum on the campus just outside Boston. The single full-time science teacher on staff at the school arranged for her class of advanced science students to visit the display on 2 December 2009. A short astronomy presentation was provided by Megan Watzke from the Smithsonian Astrophysical Observatory. The discussion was attended by a former student of the Perkins school, and also a current visually impaired Perkins faculty member. One of the exhibit guests, a girl with low vision who reads large print, bent close to the images and remarked on their bright (high contrast) colours and commented how pretty the visuals were. She later communicated to her teacher that she “had learned that the Sun is like 5 billion years old”. A male student, who is blind, felt through the entire exhibit and then exclaimed: “This is awesome.” The teacher, however, seemed to most appreciate the panel on the electromagnetic spectrum that demonstrated different kinds of light, as it can be applied to their other science class studies such as in chemistry and biology.

The group discussed relatively straightforward issues with the exhibit, such as the corners of the exhibit being too sharp for non-sighted students (especially younger

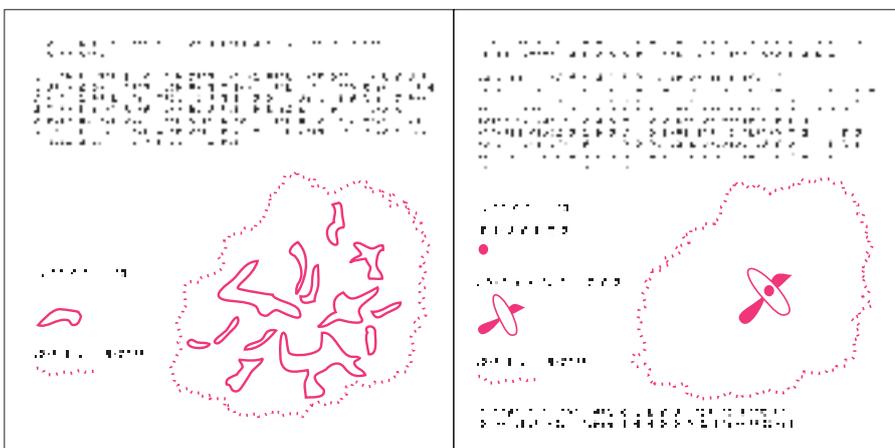


Figure 2. Braille/texture and large print/image overlays illustrating the Crab Nebula.

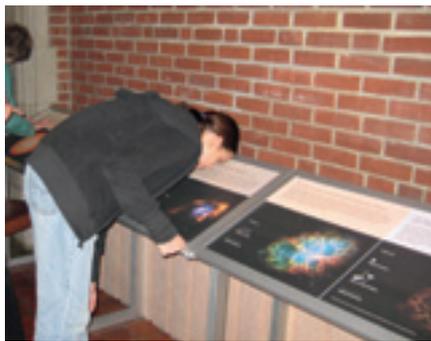


Figure 3. Teenage students at the Perkins School for the Blind experience the tactile exhibit in December 2009. Credit: Kimberly Arcand.

ones) to bump into, the Braille lines being slightly too long, or the separation ridge between image panels being slightly too small. They also discussed more difficult topics, such as how much the lack of visual memory affects the students' learning, and how difficult it is to acquire the spatial skills that are referenced so often in sciences like astronomy. Such "given" concepts for sighted students — large physical scales, complex shapes, navigation and measurement — are often very challenging for those in the non- or low-sighted communities.

Location: Atlanta Center for the Visually Impaired, Atlanta, Georgia

The Center for the Visually Impaired in Atlanta hosted the tactile FETTU exhibit from mid-October through December 2009. The tactile FETTU exhibit was located during this time in the publicly accessible lobby of the CVI facility in the heart of downtown Atlanta. Annie Maxwell is Director of the Social Therapeutic and Recreational Services (STARS) programme, which is an after-school programme specifically for youth aged 6 to 21. Ms Maxwell, who is visually impaired, commented that: "The exhibit is a wonderful eye-opener for persons with vision loss, and a great way to connect with a touch method of viewing the Solar System." In addition, she wrote, "During the school day in a regular science class the panel display should work fine in its present form; it would illustrate exactly what the sighted students are viewing, thus involving the visually impaired student completely in the learning process. However, a number of improvements could be made to the exhibit including hand-held items discussed in the panels such as the Sun or a star, and having a review question/answer and comments section at the end."

Chris De Pree of Agnes Scott College worked with a group of younger STARS students as part of the after-school programme in early November. At this time, he added to the exhibit two meteorite samples that were discussed and passed around to

students. One of the students requested "tactile" constellation maps, asking what Orion "looked like". Ms Maxwell also hosted other groups of students with the installation, including a group of middle and high school aged students. She guided a class of middle and high school students on a tour of the exhibit, as well as an elementary group. She noted that, "Students were deeply engrossed in the display for the first couple of panels, however, about halfway through, they grew restless and inattentive." There is extensive reading on some of the panels, and they can take a long time to read for younger and/or inexperienced Braille readers. The audio files of the material that are available should help address this, but adding a better mechanism to have direct audio from the exhibit (which was meant to be ultra portable and not reliant on electrical outlets) is something to consider.

Broader dissemination

The NASA-funded project at the CXC has recently produced a set of tactile/Braille wall posters containing a subset of the same image panels as the tactile/Braille exhibit. Two thousand sets of this textured poster series have been produced, which will enable a larger means of dissemination as programme resources for the visually impaired community to further enhance the longevity and sustainability of the science outreach

Conclusion

Millions of people in the United States are legally blind (1.3 million), have low vision (3 million) or have a degree of visual impairment that cannot be corrected by glasses (12 million)². The FETTU-tactile exhibit expands access for the blind and visually impaired to information about the Universe by presenting these panels in public and non-traditional learning settings. It "opens a wider door to understanding and experiencing what sighted students have been looking at and experiencing all along,

which bridges another gap in learning and levels the playing field even more". (Annie Maxwell, STARS director). Yet this is just a first step in improving the opportunities for the visually impaired community to become more involved in topics like astronomy. Additional means of accessibility such as 3D modelling of objects and processes, and improved text-to-audio awareness, as well as a better understanding of how the visually impaired community learns science, are keys to the creation of "inclusive science learning" environments that will stimulate interest and help the community become more comfortable and confident in their relationship with science (Bell et al., 2009).

References

- Bell, P. et al. (eds) 2009, *Learning science in informal environments: People, places and pursuits*, (Washington, DC) The National Academies Press

Acknowledgements

This material is based upon work supported by the National Aeronautics and Space Administration under proposal 08-EPO08-0068 issued through the Science Mission Directorate. Special thanks to Kathleen Lestition and Simon Steel of the Smithsonian Astrophysical Observatory, Cambridge, Mass.

Notes

¹ More information on the exhibit: <http://www.fromearthtotheuniverse.org/tactile.php>

² <http://www.lighthouse.org/research/statistics-on-vision-impairment/prevalence/#national>

Biographies

Kimberly Kowal Arcand is the visualisation & media production coordinator for NASA's Chandra X-ray Observatory. Along with Megan Watzke, she is co-chair for the IYA2009 From Earth to the Universe Task Group.

Megan Watzke is the press officer for NASA's Chandra X-ray Observatory. Both she and Kim Arcand are based at the Chandra X-ray Center at the Harvard-Smithsonian Center for Astrophysics in Cambridge, Mass., USA.

Chris De Pree is Professor of Physics & Astronomy at Agnes Scott College and Director of Bradley Observatory in Atlanta, Georgia, USA.