

Pioneering accessible astronomy under the planetarium dome: An interview with Noreen Grice

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Accessibility in the planetarium requires architectural accommodations for differently abled people and careful preparation of accessible content. Noreen Grice has worked in content accessibility for astronomy in the dome and publications with NASA and other organisations for many years. This interview encapsulates her work and experiences.

Preamble

Planetarium theatres stand out in the public mind as places where people can go to learn about astronomy and space science, astronomers, space scientists, astronauts, and others who are exploring the Universe. However, even with the outreach that planetarians do, an important segment of the population misses out on the message: those who are differently abled.

Accessibility for them in the dome has always been a challenge. Physical access can be handled with proper architectural techniques. However, there is also the issue of accessible content. What do you do if members of your audience are blind, low vision, or otherwise unable to access your content? Some solutions present themselves in the form of closed captioning, for example. But, to make content available to all is challenging and requires multiple solutions.

It is a challenge that Noreen Grice first confronted many years ago when she worked at the Museum of Science Boston. Noreen is widely considered the pioneer in astronomy accessibility, a topic she's dedicated her career to since 1984. Over the years, she has created a series of tactile Braille and print books and products designed to bring the Universe to these visitors. She is often asked to consult on planetarium productions and facilities. Along the way, she's broadened the Universe for people who do not sense the cosmos like others do. Noreen shared many thoughts about her groundbreaking work in a wide-ranging interview.

Noreen is now president of You Can Do Astronomy¹, the company she founded after

talking with blind and low-vision visitors about their experience at the Museum.

Noreen, what prompted you to make materials for differently abled visitors?

Back in the summer of 1984, I was an astronomy major going into my senior year at Boston University, and I had just started working in the Charles Hayden Planetarium at the Boston Museum of Science. One day,

I noticed a group of blind students in line for the planetarium show. At that time, I didn't know anyone who was blind, and I wasn't sure what to do. The manager said I should just help them to their seats, indicating that was all I had to do. So, I guided the group to their seats, stepped into the console, welcomed everyone to the planetarium and pressed the button on the computer to start a pre-recorded show. I recall the narration was something like: over here is the Ring Nebula, and over there is the Big Dipper. During the show, I followed the script and



Figure 1: Noreen Grice and Max Mutchler presented a paper about the Tactile Carina Nebula Project at the January 2010 American Astronomical Society (AAS) Meeting. The tactile prototype was tested by learners with blindness and low vision. The final version was displayed at the meeting. Scientists in attendance were encouraged to touch the different textures of the Carina Nebula. Image Credit: Noreen Grice

moved the Zeiss projector to specific coordinates.

I wondered what the students thought about the planetarium show, so when the show ended, I stepped out of the console and asked them. I thought they might say the show “was nice,” but instead, they said it was not accessible to them. I felt terrible. To me, the planetarium was the most wonderful place in the world, but clearly, it was not that way for them.

I could not stop thinking about the students walking away disappointed. The next day, I took a bus to the Perkins School for the Blind in Watertown, Massachusetts. I visited the campus library and asked if they had any astronomy books for blind students. The librarian directed me to a shelf filled with very thick Isaac Asimov books. I pulled a book from the shelf, flipped through it and saw pages with Braille code. But something was missing. I asked the librarian if Braille books had raised pictures. They explained that raised pictures are very expensive and labour-intensive, so not many Braille books have touchable pictures.

Then, I understood something crucial. The narration of the planetarium show was not descriptive, and the images projected on the dome were not accessible to visitors who were blind or low vision. I did not know how to solve this problem, but I was determined to try and figure out solutions to make astronomy more accessible non-visually. This moment changed my career and set me on a course to develop a new field of accessible astronomy.

How did your museum administration react to your efforts?

Two things happened. At Boston University, I met with one of my astronomy professors and proposed doing a directed study to write an astronomy book specifically geared toward blind or low-vision learners. This book would be very descriptive, have Braille and print text with raised pictures, and would be called *Touch the Stars*. The professor (Dr Janes) agreed, and I began work on the book.

At the Museum, I think my manager was a little uncertain about creating materials for blind visitors. But, I wanted to learn how to

make tactile images, so I visited the Massachusetts Association for the Blind. A volunteer showed me that she glued string to cardboard to make tactile images. Then, I went to Howe Press at the Perkins School and learned that I could make images one at a time using special plastic pages and etching tools. I purchased a tactile drawing kit and began to teach myself how to make tactile images. I bought a template of Braille characters and practised making Braille labels and raised patterns. I wanted to create a series of tactile pictures on topics that could be used in any of the planetarium shows. It was a very slow process, and took me weeks just to make one image.

By the time I graduated from Boston University, I had completed the text and identified the types of tactile images needed for *Touch the Stars*. However, the lack of available technology prevented me from producing it. So I packed up my work in a box, left Boston, and headed to San Diego State University to complete my Master’s degree in astronomy. When I finished, I

returned to Boston and to the Museum of Science and picked up where I left off. I got a grant to purchase a Braille embosser, and I redrew all of the designs I had made on the plastic pages with a mouse and saved it to the computer. Once I had the design saved, I could quickly print out copies of the images and create tactile picture booklets for all of the planetarium shows. Finally, there were tactile picture books for every planetarium show!

Then, I approached the Vice President of Education about using the Braille embosser to create the tactile images for *Touch the Stars*. National Braille Press could print the text pages in Braille and print, as long as I provided the accompanying tactile images. The Museum of Science agreed to act as publisher, and the first edition of *Touch the Stars* came out in 1990. Since then, it has gone through many updates and expansions. National Braille Press is now the sole publisher of the 5th edition of *Touch the Stars*. It has received very favourable reviews in *Sky & Telescope* and *Physics Today* magazines.



Figure 2: Noreen Grice reads a pictorial description of features in the Carina Nebula to a low-vision student who is exploring the first of three different tactile prototypes of the nebula at the National Federation of the Blind Youth Slam. Image Credit: Noreen Grice

So, you founded your company – which you describe in your motto as an accessibility design and consulting company focusing on making astronomy and space science accessible to people through universal design. What kinds of projects have you taken on in this effort?

I named my company “You Can Do Astronomy LLC” because I want to promote a positive message on making astronomy accessible for learners of all abilities. Whether you learn non-visually or have a disability-related to mobility, communication, learning or hearing, you can do astronomy, too!

Originally, I began my accessibility work for learners who are blind or have low vision. I created tactile images that were available any time a blind or low-vision visitor came to the planetarium.

But, it was time to tackle another problem. While at the Museum of Science, I turned my attention to visitors who were deaf or hard of hearing. At that time, one sign language-interpreted show was offered every other month on a Saturday morning. That meant visitors who were deaf or hard of hearing had to plan well ahead to visit the planetarium. If they missed the specific show and came to the planetarium at any other time, they were out of luck.

That didn't seem fair to me. I began exploring captioning options and found that the local public television station (WGBH Boston) was also testing potential captioning devices for theatres. I participated in a test they did with three different devices at a local movie theatre. One of the devices, a vacuum fluorescent display, was the size of a shoebox and was attached to the back of a theatre seat in a metal housing. I thought this device had potential for use in the planetarium.

I contacted Design Continuum, an engineering design company. They agreed to donate the research and development, and I got a grant to pay for materials. It took over a year of testing, but the new modular captioning system debuted in the Charles Hayden Planetarium in 1996. It could display narration in the form of text from pre-recorded programs and was used for about 20 years.

A surprising thing happened: people who spoke English as their second language requested captioning because they said for them, it was easier to understand English by reading rather than by listening. This was a great lesson in how an accommodation for one group can be an accommodation for others, much like how a curb cut designed for people with mobility disabilities is used by many people, especially those pushing baby strollers. I also received a different grant for the planetarium assistive listening system so people who needed volume amplification could borrow a unit and adjust the volume to their specific needs.

Beyond my work at the Museum of Science, I edited a book for the Great Lakes Planetarium Association entitled *How to Make Planetariums More Accessible to People with Disabilities* (1996). I wrote and designed the tactile images for three NASA Braille/print books, a children's book about learning the Moon's phases and a combination educational/travel guide on accessible astronomy and places to visit. Most recently, I collaborated with planetary

astronomer Dr Heidi Hammel and co-wrote the digital book *Touch the Solar System*, published in 2022.

I designed tactile graphics for the Space Telescope Science Institute (3D representation of NGC 602 (2014) and The Tactile Carina Nebula² poster (2010)) and tactile images for a different NASA book (*Touch the Earth: A Multimedia Book about Earth's Biomes* (2010)). Some of my tactile designs have been used in museums and visitor centres. I created tactile graphic designs for the *Chandra X-Ray Observatory Exhibits* (From Earth to the Solar System (2009), Here, There and Everywhere (2014) and Light Beyond the Bulb (2015)) and the tactile designs for *The Solar System Radio Explorer Kiosk Exhibit* (Goddard Space Flight Visitor Center, 2007). Recently, I designed accessible modifications for outreach activities in the *Big Astronomy* outreach toolkit (2022).

How have you seen your efforts grow across the domed community over the years?



Figure 3: Noreen Grice speaks with a conference participant and discusses how astronomy topics were made more accessible to blind and low-vision high school students during the National Federation of the Blind Youth Slam (held at Johns Hopkins University). Image Credit: Noreen Grice



Figure 4: Noreen Grice stands inside a tactile tent and guides a low-vision high school student as he explores a tactile picture of a constellation during the National Federation of the Blind Youth Slam. This tactile tent was built by teacher Ben Wentworth and his students at the Colorado School for the Blind and brought to Johns Hopkins University for this event. Image Credit: Noreen Grice

In 1984, when I first began my efforts to make astronomy and the planetarium more accessible to blind or low-vision audiences, I was the only person doing it. I made presentations at planetarium and astronomy conferences, displayed my tactile materials, and advocated for more accessibility in the planetarium. Over the years, educators have contacted me for advice on how to make their facilities and programs more accessible, and people with disabilities have contacted me asking where accessible astronomy places are located. Those questions prompted me to write the resource book *Everyone's Universe: A Guide to Accessible Astronomy Places* (2011, 2012).

Over time, students, educators and amateur astronomers began expanding upon my work, creating their own tactile materials and testing methods of applying different sounds (sonification) to represent different characteristics of astronomical objects. I'm pleased to see that there are more people now interested in making the planetarium welcoming and accommodating for people who are using different strategies for learning.

How did NASA get interested in your work?

After *Touch the Stars* was published, I received an email from Dr. Bernhard Beck-Winchatz of DePaul University. He was working in the NASA Broker Facilitator office at DePaul and saw the book in a Chicago bookstore. He wondered if it was possible to do something like that for the *Hubble Space Telescope* images. We applied for and received an E/PO (Education/Public Outreach) grant to develop a new Braille/print book with *Hubble* tactile images. The grant was received, and Ben Wentworth, a teacher at the Colorado School for the Blind, tested my tactile designs with his students. In June 2001, Bernhard, Ben and I presented a paper and participated in a press conference at the American Astronomical Society conference with a few prototype copies of the book. National media picked up on the project, and *Touch the Universe: A NASA Braille Book of Astronomy* was published in 2002 by Joseph Henry Press, an imprint of the National Academies Press. I was told that it was the first Braille book on Amazon!

After it was published, I was approached by Dr. Joseph Gurman and Dr. Steele Hill at Goddard Space Flight Center and asked to create a tactile book about solar science. *Touch the Sun: A NASA Braille Book* was published in 2005. In the third NASA book, I collaborated with two other authors (Dr. Simon Steel and Doris Daou) to write a book about astronomical objects not visible to any human eyes. *Touch the Invisible Sky: A Multi-Wavelength Braille Book Featuring Tactile NASA Images* was published in 2007.

How many books do you have out now?

I am the author of seven accessible astronomy books...currently! They're all listed on my website, along with other projects in progress.

Are they quite widely used?

I have found my books in museum gift shops and libraries across the United States. Many planetariums, amateur astronomers and astronomy instructors have copies of my books ready to pull out for learners who are blind or have low vision. They are proactive in teaching non-visual audiences. I love that!

What sort of feedback do you get about the books?

I often get feedback when I least expect it. Occasionally, I'll receive an email from an educator who is using my books as resources in their planetarium or classroom or from a person who is using a book (say, *Touch the Stars*) as a resource for their own learning. I remember meeting a 13-year-old girl in 2005 at the book launch for *Touch the Sun*. She and her mother had driven hours to be there. She carried a big bag with my other books for me to sign, and she told me in no uncertain terms that she planned to be the first blind astronaut on Mars! The last time I attended the National Federation of the Blind conference in person, I went to the Science and Engineering Division meeting. We went around the room and said our names so everyone knew who was there. When I said my name, two college students immediately turned around and said that it was my

books that got them interested in science, and my books made them believe they could be scientists, too. I can't tell you how that tugged at my heart.

If a group or organisation has funding and wants to involve you in a new accessibility project, would you be interested?

Definitely! I enjoy new challenges and the opportunity to create methods and materials for removing barriers for all learners. My goal is for people of all abilities to experience the universe in new ways, get excited to learn more, and maybe become a scientist and contribute to new discoveries themselves. We live in a time where technology has made the world a community where we can all be involved, where

accessibility is or can be made available, and where we can all do astronomy together. I hope to be involved in accessible astronomy for another 40 years! I can be contacted through my homepage¹.

What's your next project?

I can't tell you until it's published. Stay tuned!

Any final thoughts?

I have been working with the National Federation of the Blind since 2002. I became a member in 2003 and served on the Board of Directors of the Central Connecticut Chapter of the National Federation of the Blind. It's not okay to create materials for a group of people without making sure it's a good fit. I feel that it's important to work directly with the target audience, and I work with non-visual learners to test out my tactile designs and materials to be sure they are working as intended. I also teach astronomy education workshops at schools and museums for blind or low-vision students and their teachers.

Notes:

¹ For more information about Noreen Grice, her work, and how to contact her, refer to her webpage: www.youcandoastronomy.com

² Additional information about the tactile Carina Nebula can be found online at www.nasa.gov/mission_pages/hubble/science/carina-touch.html.

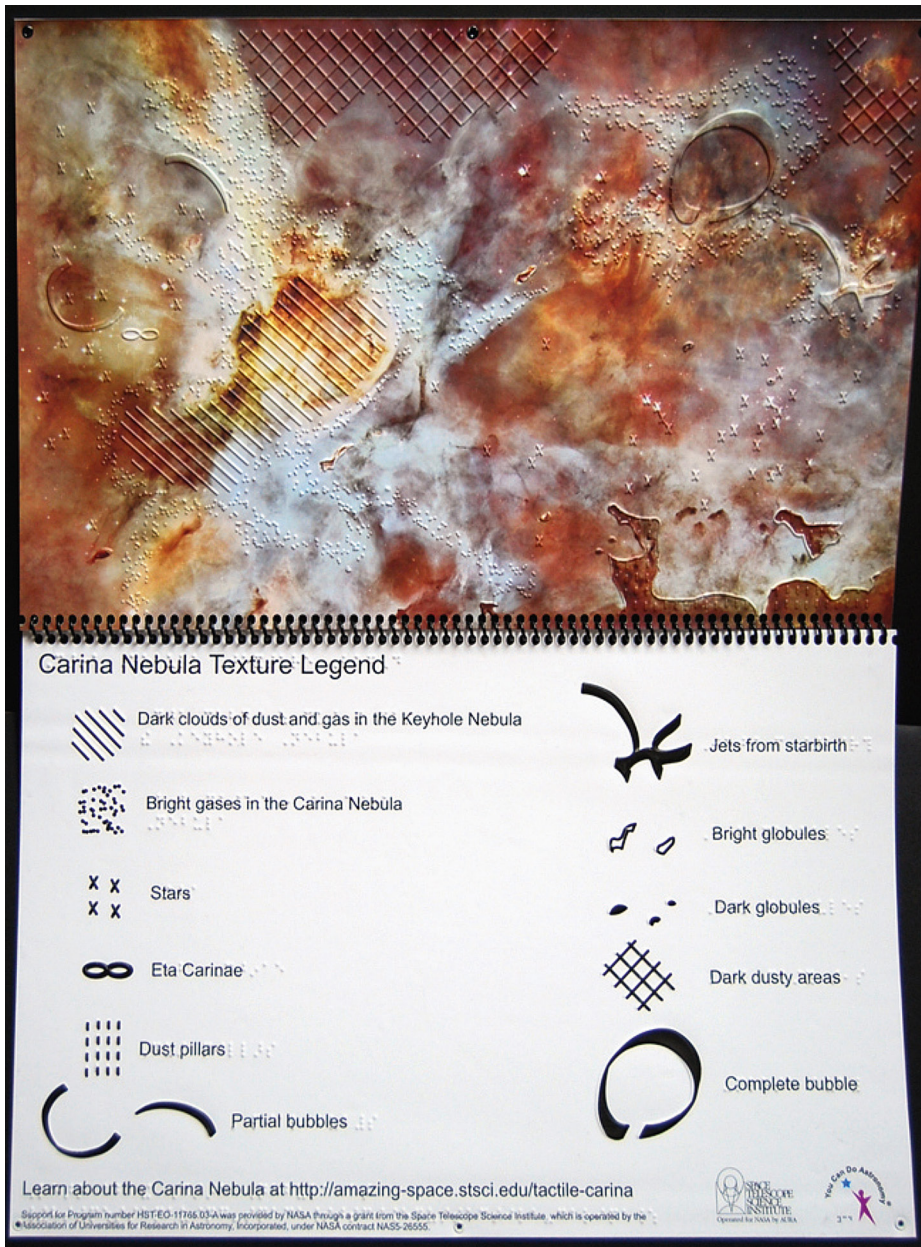


Figure 5: This is the final tactile Carina Nebula poster produced for the Space Telescope Science Institute in the summer of 2009. The top half (above the spiral binding) highlights different aspects of the nebula, matching visual elements of the nebula's image with tactile features. The bottom half (below the spiral binding) is the Carina Nebula texture legend, which identifies by touch, print and Braille, each of the featured textured areas of the poster. Image Credit: NASA, ESA, Max Mutchler and Noreen Grice

Biography

Carolyn Collins Petersen is a long-time planetarian and science writer of 8 astronomy books and many articles. She is the CEO of Loch Ness Productions and has created a number of dome shows. She also writes and consults on science exhibits for clients such as Griffith Observatory, NASA-JPL, the California Academy of Sciences, and the Shanghai Astronomical Museum.