

# Accessible Astronomy Activities for the Blind and Visually Impaired in Puerto Rico

Gloria M. Isidro Villamizar<sup>1</sup> , Carmen A. Pantoja Pantoja<sup>2</sup> and Mayra E. Lebrón Santos<sup>3</sup>

<sup>1</sup>Caribbean University, Bayamón Campus  
Department of Liberal Arts  
167 Ave. Km. 21.2 Bayamón, PR, USA, 00960-0493  
email: [gisidro@caribbean.edu](mailto:gisidro@caribbean.edu)

<sup>2</sup>University of Puerto Rico-Río Piedras  
Natural Sciences Faculty, Department of Physics  
17 Ave. Universidad Ste. 1701 San Juan, PR, USA, 00925-2537  
email: [carmen.pantoja1@upr.edu](mailto:carmen.pantoja1@upr.edu)

<sup>3</sup>University of Puerto Rico-Río Piedras  
General Sciences Faculty, Department of Physical Sciences  
14 Ave. Universidad Ste. 1401 San Juan, PR, USA, 00925-253  
email: [mayra.lebron3@upr.edu](mailto:mayra.lebron3@upr.edu)

**Abstract.** We present the design and development of accessible activities in astronomy for blind persons in Puerto Rico. We design for a diverse audience that sees from different perspectives, but with the same purpose: to know and discover the Universe. We adapt tactile materials to develop themes that require visual images. We design and develop three-dimensional tactile material to offer blind people the opportunity to get the conceptual idea of the specific topic under consideration. Listening and designing bearing in mind the voice of blind people with their different life experiences is essential. Through years of experience (2006 – 2020) we have learned to use new strategies in the design and development of tactile materials. We recognize that what we have achieved to date has been possible through the exchange of efforts, collaboration, and volunteering. In recent months, we have been publishing videos with each of the tactile materials, with the purpose of contributing to the literacy of astronomy worldwide.

**Keywords.** Accessibility, astronomy, blind people, person with disabilities, tactile materials, popularization of astronomy.

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## 1. Introduction

Discovering the night sky has been of interest to all mankind, since ancient times. Even without vision, it is still of great interest to imagine and discover celestial spectacles and to have knowledge of our Universe. Raising awareness of the general public and integrating blind people and people with low vision into astronomy outreach activities to offer “everyone” the opportunity to know and discover the Universe is our purpose. Since our beginnings, we have listened to the voice of blind people (collaborators) for whom our activities are directed.

## 2. Tactile materials

We adapt tactile materials to cover topics that require visual images. In some cases, it has been necessary to design and develop three-dimensional tactile material to offer



**Figure 1.** Workshop in Israel.

blind people the opportunity to get the conceptual idea of the specific topic under consideration. For other cases we have used available commercial materials to aid in the description of concepts like relief drawing paper, Braille books, Braille paper and stylus, among others. We have used available educational materials like the ALMA 12-Meter Antenna Paper Models from the National Astronomical Observatory of Japan (NAOJ 2021). We constructed 66 paper models of the ALMA antennas and organized inclusive events for their use. We designed a model of the Arecibo radio telescope that can be assembled, with the purpose of making blind people, together with their family or friends, to participate in the visit to the Arecibo Observatory radio telescope. The model integrates mathematical concepts in its structure, and is accompanied by three “Visitors Guide” booklets, printed in large print, in Braille, in Spanish and English (Bartus *et al.* 2007). We are saddened by the news of the recent collapse of the radio telescope.

### 3. Workshop experience

The area of accessibility in science and mathematics benefits greatly of the dialogues and exchanges in experience between the interested parties. We have participated and organized workshops for teachers, students, astronomers, and popularizers of science. We organized a workshop (Alonso *et al.* 2008), with the topic of the phases of the Moon. This workshop included blind participants. It is important to encourage events in which the blind and the sighted can participate to promote awareness in the public towards disabilities. We developed an inclusive workshop to prepare a group of interdisciplinary college level students to work as volunteers during the planned events for the International Year of Astronomy (IYA2009). Our group of students included two totally blind students and they all learned about tactile materials and used them during our outreach events in 2009 (Isidro 2009). Isidro was invited to participate of the IYA2009 Israel, and offered a workshop for future teachers in Special Education in Afula (Fig. 1).

### 4. Collaboration with other experts

One of the challenges in the development of accessible materials is the large spectrum in which a disability can be manifested. We have collaborated with different groups of experts in the design and evaluation of models. We have collaborated in the tactile Moon project of the Astronomical Observatory of the University of Valencia (Ortiz Gil, A.,

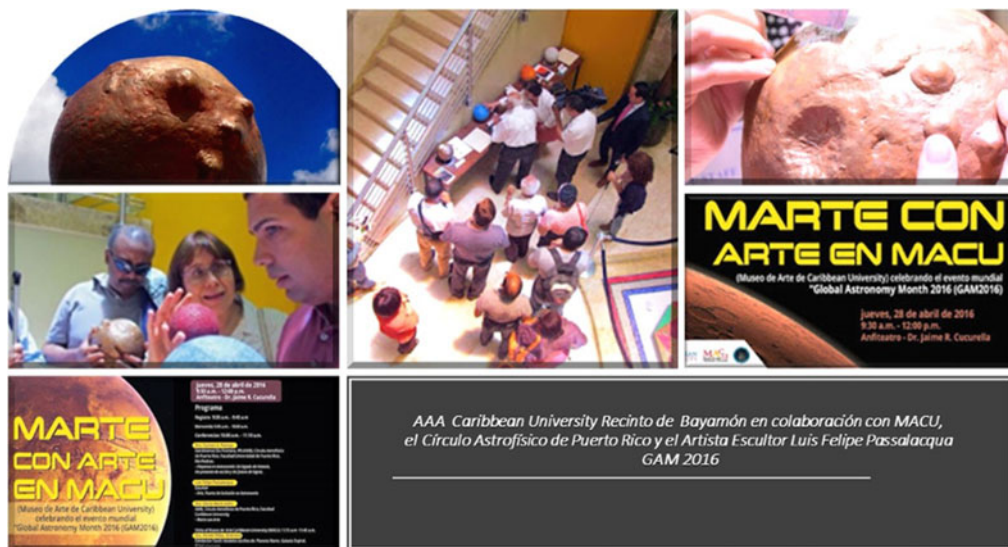


Figure 2. Mars with Art

*et al.* 2012). We evaluated the book “The Sky at your Fingertips” together with blind undergraduate students at UPR Río Piedras. We had on loan the tactile semi-spheres and presented the Planetary Show “El Cielo en Tus Manos” at the University of Puerto Rico.

## 5. Astronomy through Art

We have employed a technique to create astronomy tactile models that are sculpture to focus and simplify the astronomy concepts we wish to present. We designed the model of the tactile Sun, a sculpture piece containing eruptions, flares, and a sunspot in relief. This strategy was made possible by participating (Gloria Isidro) as a volunteer in the “Manos Que Miran” sculpture workshop under the direction of the blind sculptor Luis Felipe Passalacqua at the Puerto Rico Art Museum. (Isidro and Pantoja *et al.* 2014). Using this technique we developed a tactile model of a Spiral Galaxy and presented it during the activity “Stars for All”, as part of the activities of the International Year of Light 2015. We created “Mars with Art” a sculpture that contains artistically expressed selected features of the Martian surface (Fig. 2).

## 6. Activities for associations of blind people

We develop Astronomy activities with older adults who are new to reading and writing Braille. The different textures on tactile materials and Braille books are an excellent motivational strategy with Braille writing. We have collaborated developing accessible activities with the Puerto Rican Association of the Blind, Inc., in Río Piedras, and with the “Luz de Amor” Association of the Blind, Inc., in Bayamón, Puerto Rico (Fig. 3).

## 7. Accessible Astronomy Activities & COVID19

During this time of global pandemic we have shifted from displaying tactile materials to describing already developed materials. To “touch” is to “see”, and to “hear” is to “imagine”. We are making video recordings with each of the tactile materials already developed and sharing our experiences, so that they may be useful in disseminating astronomy for the blind. We continue to develop 3D materials as future projects.



Figure 3. "Asociación Puertorriqueña de Ciegos"

## 8. Conclusions

We design for a diverse audience that sees from different perspectives, but with the same purpose: to know and discover the Universe. Listening to the voice of blind people with their different life experiences is essential when adapting or designing tactile materials. Through years of experience (2006 – present) we have learned to use new strategies in the development of tactile materials. We recognize that what we have achieved to date has been possible through the exchange of efforts, collaboration and volunteering. Our biggest obstacle is the time to design, develop, evaluate new strategies, publish them, give them continuity and follow-up. We have been successful in creating tactile models that are sculptures for which we have carefully selected features to highlight, simplify and focus astronomy themes. We recommend to join forces to create and develop new accessible activities and materials.

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