

# Astroaccessible: Bringing the study of the Universe to the visually impaired

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## Abstract

Astroaccessible is an outreach project carried out in collaboration with the IAA-CSIC and ONCE to make astronomy more accessible to the visually impaired people so the main source of information is not based on the use of images. The activities of the project started in 2014 and since then it has received financial support from SEA in 2015 and from FECYT in 2016 making possible to extend the activity for many ONCE centres in Spain. The activities include in-person classes using adequate descriptions, high-contrast images for those people with visual remain and touching material representing basic concepts about sizes, scales and distances of astronomical bodies. To maximize the impact of the contents of the project many of the contents, summary of activities, links to resources are available through the web page of the project. This project focused on astronomy is also intended to make the scientific community more sensitive to perform more accessible explanations of their results.

## 1 Introduction

The popularization and teaching of science for every public is and must be one of the pillars of the formation and establishment of a general culture for any individual. The constant scientific and technological advances that are being produced nowadays must be together with the diffusion and appropriate explanation for the whole society This fundamental objective cannot be satisfactorily carried out without the inclusion of all impaired people and those who due to their characteristics cannot access to all the divulged contents [2].

Astronomy, encompassing in this category astrophysics and cosmology, is one of the branches of science that has grown much and it is providing more new scientific results. This is partially motivated by the investment in new facilities for the observation of the Universe

including large telescopes, space observatories, or missions to objects in our Solar System. The new data and findings coming from them always have a great impact in the media.

Given that a great part of the dissemination of these results is predominantly done by means of a visual support (e.g. pictures, videos, animations, graphics), visually impaired people are excluded from having whole and satisfactory access to all these contents. Although there is a growing conscientiousness to adapt part of the scientific information intended to teach or divulge, we are still far from reaching some minimum required objectives to make accessible all content for everyone. As an example, it is not usually taken the heterogeneity of visual impairment into account. Most of visually impaired people have visual memory, so the needs and approaches are in any case very different to make accessible the information intended to be divulged [1].

The project *Astroaccesible* started with the aim of approaching astronomy to visually impaired people by means of conferences, in-person classes, and the creation of adapted contents and materials to make more accessible the astronomy teaching and the outreach of the last discoveries in its different branches. The project has also a social dimension, as the principal investigator, Enrique Pérez-Montero, is visually impaired and belongs to the Spanish National Organization for Blind People (ONCE). Therefore, to give visibility to impaired scientists and teachers helps to transmit an idea of social inclusion and gives a reference for the other impaired people.

In this proceeding we describe the fundamental aspects of the *Astroaccesible* project, including its specific objectives, activities carried out so far, resources and materials, the impact of the project and the perspectives in the near future

## 2 Description of the project

The project *Astroaccesible* has the aim of the popularization of the astronomy among visually impaired people. Between the specific objectives there are the teaching by means of conferences, in-person classes, the creation of accessible materials and adapted contents so the society becomes more sensitive to include visually impaired people at all levels.

The teaching activities started in December 2013 in the ONCE site in Granada with an astronomy conference for the visually impaired people by Enrique Pérez-Montero. During 2014 similar activities were carried out (May 2014: Málaga, July 2014: Santa Cruz de Tenerife). These experiences were received with great acceptance by the ONCE and were presented in the session for teaching and popularization of astronomy of the X<sup>th</sup> Scientific Meeting of the Spanish Astronomical Society (SEA, September 2014, Teruel). Thanks to the logistic support from ONCE and the financial support from the SEA during 2015 the project has continued its growing and the activities have been multiplied. During 2016 the project could continue its activities through different ONCE sites in Spain thanks to the financial support from FECYT (Fundación Española para la Ciencia y la Tecnología).

In all activities we had adapted materials that allow the visually impaired to acquire spatial notions using touch and complementing the explanations made with the voice and also using high-contrast images that take into account those people with a visual remain in.



Figure 1: Some pictures of the conferences carried out during 2015: left, Asturias and right, Granada.

The in-person classes have as main objective to motivate the study of the astronomy for all public over-passing the idea that it can only be studied using the sense of seeing. This is done by means of a description of different astronomical systems, their sizes, and relative distances using examples and the adapted material. In the final part of the conferences we follow a guided tour in the main northern constellations with hemispheres in relief representing the night sky.

In addition to the in-presence courses, we have developed a webpage (<http://astroaccessible.iaa.es>) used to announce the upcoming activities, to introduce the aims of the project and its members, and to give diffusion to other contents and accessible explanations, such as articles.

### 3 Resources and materials

The main resource for an accessible popularization of the astronomy for visually impaired people is a complete description of all elements, and not mainly based on the use of images. This description can be carried out by means of a written support or using the voice. In most occasions it would be enough adding an appropriate description to the presented images helping to have a much more inclusive and accessible explanation. This is the reason we have focused on detailed descriptions of the concepts and contents presented in the conferences and in the articles available in the web page of the project. This strategy is the most adequate from the point of view of visually impaired people and it is the simplest and the one that needs less additional resources.

On the other hand, the collective of visually impaired is very heterogeneous and most of the members of ONCE keep a visual remain, though this is very variable: lack of central vision, lack of peripheral vision, lack of color sensitivity, lack of contrast sensibility, photophobia, night blindness, etc caused by different pathologies. For this reason all descriptions are also given with the support of high-contrast images or with different sizes. The use of images also helps to explain concepts to other non-visually impaired assistants to the activities. These images also help to be more sensitive with the kind of visual limitations that visually impaired have and are a guide to other teachers by becoming a reference about



Figure 2: Examples of touching sheets representing basic concepts about astronomical systems.

which is the kind of images of people.

In addition, some of the explanations are reinforced with the help of touching sheets, designed to transmit simple concepts about relative sizes and distances of several astronomical objects. For instance, the relative distance of the system Earth-Moon, the relative sizes of the planets of the Solar system and the Sun, or the shape of the Milky Way with the position of the Solar system in the disk.

All these sheets are labelled with texts in Braille language and normal text using high-contrast fonts to reach all people who do not know Braille language., as this system is not usually used by people with a visual remain.

In the final part of the conferences, we use hemispheres that represent the night sky with some of the constellations of the northern hemisphere in relief. The stars are shown as balls whose size depends on the brightness of the corresponding star. The stars in a constellation are joined using solid lines in relief, while to move to another constellation we use dashed lines in relief. To guide people during this virtual tour it is also used an audio narration that explains the history and objects in each constellation and describes the path to move from one to another. At same time, images of the corresponding constellations and objects are also shown in a screen. The tour is supervised by a teacher or instructor who helps the participants by guiding them through the hemispheres. This material was designed by the Observatori Astronomic of the University of Valencia as part of an activity of the International year for Astronomy in 2009 [2].

It is also used a 3D model of the Moon with labels in Braille language that allows to perceive its craters and mountains and landscape [3].

There are other resources used as part of this project, available in the web page (<http://astroaccesible.iaa.es>). including links to other resources, calendar of activities, and articles focused on astronomy using an approach not based on the use of images.

## 4 Impact and continuity

The Astroaccessible project has had a great acceptance in the ONCE and the people who attended to the different activities. Many of these activities have been broadcasted in different media which helps to give a certain repercussion to the need of doing inclusive science and to give visibility to those impaired scientists, who can constitute a valid reference for all other impaired people. In this manner the project has been presented and shared with other researchers in workshops devoted to outreach of science (e.g. III Jornadas D+i about Innovation in Popularization, Zaragoza, 2015).

Our aim is continuing the activities carried so far, reaching other ONCE sites, sharing the used touching and on-line material through the web of the project and encouraging and instructing teachers and scientists to make their outreach task more inclusive.

Our project has had financial support from SEA in 2015 and from FECYT in 2016 to cover the travels to different ONCE sites in Spain. The 2016 project is being developed with the institute Estación Experimental del Zaidín - CSIC in Granada focused on Agronomy to also develop an inclusive activity to teach Agronomy to visually impaired people, applying some of the strategies used to teach astronomy, demonstrating that these can be also utilized in other branches of knowledge.

During these two years the logistical support from ONCE has been fundamental to reach to as many visually impaired as possible, using their centers and resources and their advice to develop materials. With the support of these institutions we hopefully will continue our activities, developing more material, more contents and explaining our experience to other teachers in other branches of science in the near future. This will help to create more available contents to people who in other circumstances would not access to them.

## 5 Summary and conclusions

Astroaccessible has demonstrated with all the activities carried out in the last three years that developing a more inclusive outreach is possible by means of adequate explanations, strategies, and resources. The use of voice and descriptive texts as basic element of these explanations not based mainly on images breaks all barriers when we want to gain access to all those who cannot use the sense of seeing. In addition, to be aware of the large heterogeneity in the visual conditions of many of these visually impaired people allows us to use images as a support in many situations for those with a visual remain. Traditionally visually impaired people have been treated as totally blind, not considering this heterogeneity. In all case, the employment of adapted material to transmit ideas about relative sizes, shapes and distance is also a valuable resource in those cases when a complete description is not so efficient.

Our project complements its activities with the diffusion of contents in the web (<http://astroaccessible.iaa.es>) and has funding and logistical support from SEA, FECYT, and ONCE together with the great human experience on astronomy outreach from the Popularization Department of the Instituto de Astrofísica de Andalucía and the previous experience on the learning for impaired people in the Observatory of the University of Valencia.

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## **References**

- [1] Benacchio, L., Dall'igna, E. & Nobili, L. 2000, *Giornale di Astronomia*, 2, 27
- [2] Ortiz-Gil, A., Gómez Collado, M., Martínez Nuñez, S., Blay, P., Guirado, J.C., Gallego Calvente, A.T., Lanzara, M., *Communicating Astronomy with the Public Journal*, Issue 11, Julio 2011. pp 12-15.
- [3] Ortiz Gil, A., Fernández Soto, A., Ballesteros Rosell, F., Moya, M.J., Lanzara, 2012, *Astronomía*, 160.