Best Practice

Communicating Astronomy to Children in Unconventional Locations

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Keywords
Education, astronomy, science communication, outreach

Communicating astronomy to children can take place in many locations outside of conventional learning spaces such as classrooms, planetariums or museums. For example, book or toy shops can provide great backdrops for communicating astronomy. It is in these kinds of places, full of distractions, that finding entertaining ways to communicate concepts becomes all the more important. Used in the right way what might initially seem like downsides to these spaces can quickly be turned into advantages. This article explores the role of these locations in communicating astronomy and how they can be used as effective, and fun, forums for engagement.

Is it possible to talk about astronomy effectively in a book or toy shop?

This is the question I asked myself when I was first asked to design short astronomy courses for children in some quite unusual places. These locations included book and toy shops that specialised in science education and entertainment and wished to extend what they could offer to customers.

The courses had to be organised as a series of four or five hour-long sessions which, according to the requirements of the promoters, had to be packed with reliable and instructive information, but characterised by a playful and entertaining atmosphere. In order to encourage an informal and friendly atmosphere, parents were allowed to attend as well, but just as a passive audience. Moreover, the groups were likely to be mixed in terms of age, which could range between five and nine years old.

As a science communicator, this was a challenge that immediately captured my interest, but the main problem in my mind was how to keep the children focused for that length of time in a setting with books, games and toys displayed around them.

Mathematics and equations were forbidden, but the host shops did provide some equipment like a small children's corner with a table, a large monitor or a small planetarium.

I took up the challenge and now, after two years of experience, I can draw some conclusions. What I have discovered is that more or less everything is possible with due preparation, some tricks, lots of patience, improvisation in the face of the unexpected, and a bit of practical psychology. Plus, not to be forgotten, some throat lozenges!

***Figure 1**. A small unconventional classroom inside a children's bookstore. Here I taught astronomy through fun using a computer, videos, books, drawings, a small planetarium and some small games.*

Astronomy on my mind

Although we can believe that there is just one science of astronomy, the truth is that in each child's mind there is a unique and very personal view of astronomy. For this reason, the very first step is to understand your students and why they are interested in the subject. More specifically, it is fundamental to understand what they would like to be told or what they would like to do. Another important issue is to understand their attitude, and in this sense age plays an important role. With kindergarten children, you can expect very spontaneous reactions, while older children who are already going to school are usually warier.

Astronomy deals with some very intriguing and visually interesting objects and with a computer, a projector and the right software you can bring these to life with fantastic shows that are very effective in holding the children's attention and breaking the ice. One good idea is to start each lesson with a short clip, prepared with a specialised programme like Celestia[1]. For example, you can show a hypothetical journey in the Solar System, or show-

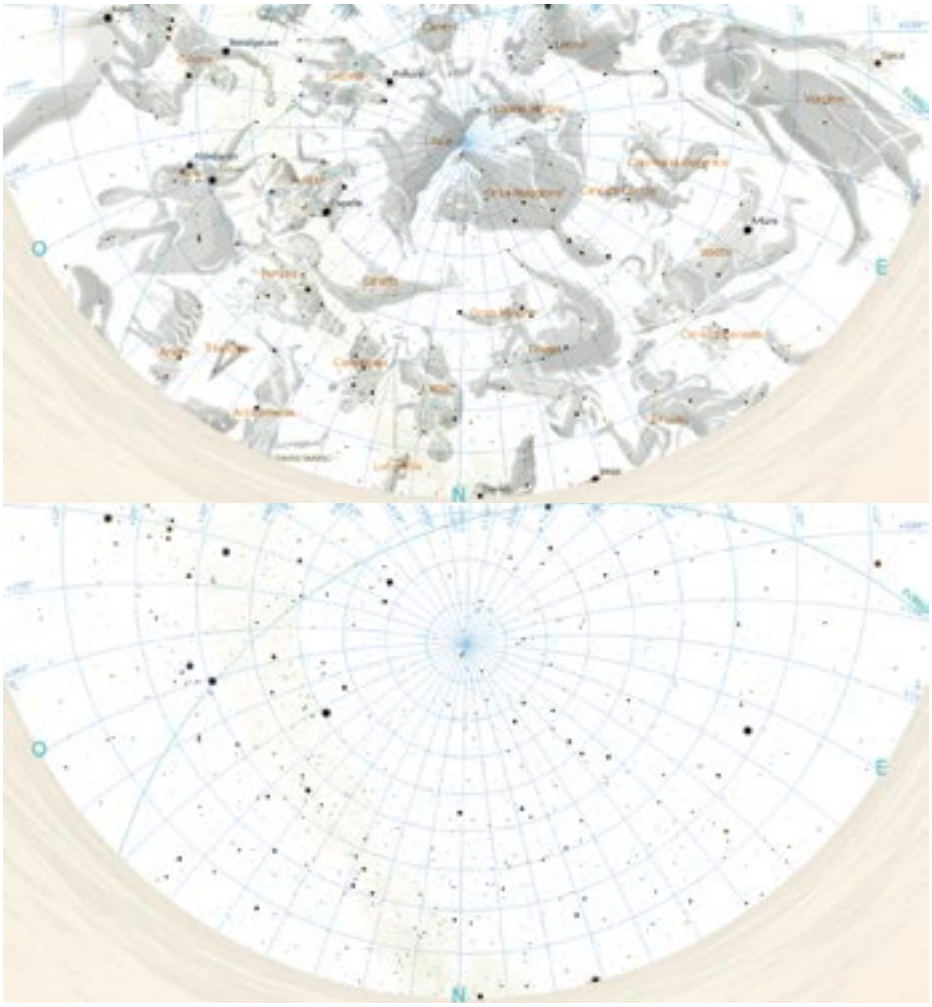

Figure 2. *Stellarium is a good piece of software for showing the night sky. You can choose the date and location so it can help with teaching about the movement of the constellations over the year. The bottom image shows how it can be used to let children draw their own constellations on the sky.*

case the constellations. This should typically last for less than fifteen minutes, and you can easily comment verbally over the images, adapting your remarks to the specific needs of the audience.

There are many advantages to this approach. One is that it helps you to identify the different personalities in your audience. There is the dreamer, eager to discover the worlds around us; the rationalist, who thinks about the lack of oxygen in space and on other planets; and the worrier, seriously concerned when they learn that the Sun will eventually die, and wanting to know how many billions of years we still have, to name but a few. Another advantage is that the participants are naturally involved in the course, without the need for questioning or forcing. They are encouraged to participate with comments and questions, and any former knowledge acquired from books, television or planetarium shows is reinforced. After this video, I generally have to leave a good chunk of time during which to answer the questions that inevitably arise.

Usually at this point, if the attendees are very young (under around six years old), drawings of the Solar System planets are distributed and coloured with my assistance, using the bookshop's products on this subject as a guide. It is important to let them be as independent as possible during this task. The very fact of having to choose the right colours naturally stimulates their observing skills, and their curiosity: why does Neptune have that blue colour while Mars is reddish? Since they are leading the game, the answers about chemical composition are followed with great curiosity and learned much faster and more easily than when the information is offered without being asked for.

Sizes and scale

Generally, during the Solar System movie, the problems of the size of the objects and the distances in space emerge organically. For the size of the planets it is very helpful to use drawings with data sheets for the various planets, but the best way is always to compare the sizes of different objects with the help of images specifically created to help the children understand the objects' relative proportions, for example, by comparing the Sun and the Earth.

To make it clear that the Sun is just one of many stars I often use another movie that shows the size of different stars by gradually introducing bigger and bigger stars until we meet the biggest one known up to now. This naturally leads the discussion to the stars' locations, so it is easy to introduce celestial maps, the constellations, the seasons and finally the children can even learn how to use sky charts.

When available, a small planetarium is a great plus. It can be used to show the daily and seasonal motions of the stars and the planets, making it possible to immediately appreciate the difference between these two types of celestial objects. It is also possible to identify the major constellations and to locate the North Star using the Big Dipper, and therefore to introduce the concept of orientation by means of the stars.

At the end of the session it is a very good exercise to show an image of the sky as it will be that night and a map with the main celestial objects so that they can try to observe it that evening. Crossing the border between a simulated observation inside and that of the real sky can be very important. If you are lucky and are conducting a course at the same time as a major celestial event like an approaching comet visible to the naked eye, then drawing the group's attention to this and how to observe it is a must.

See beyond

Artificial satellites are charming, and it is not unusual to read in the news about

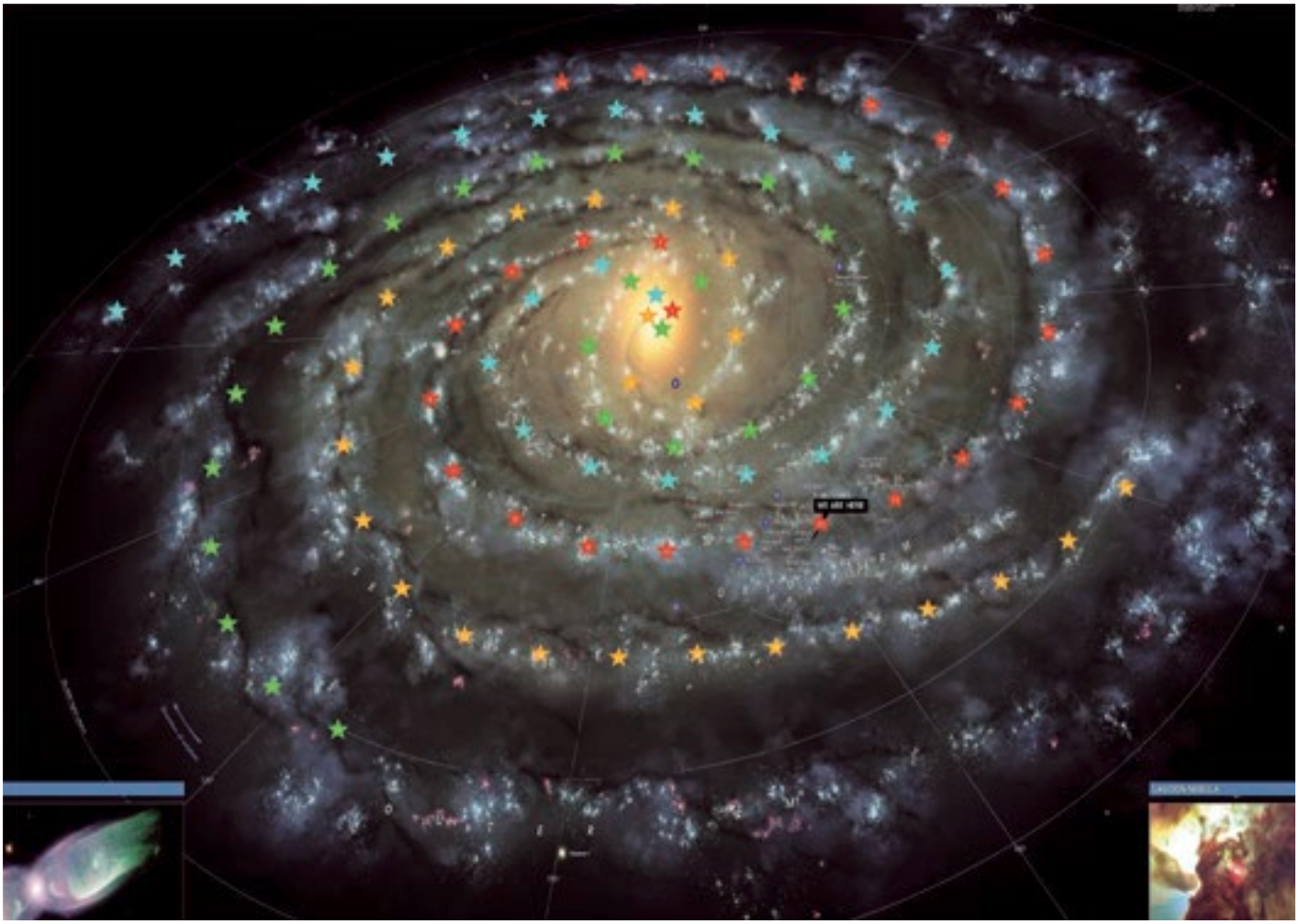

Figure 3. *At the end of a short course, generally after four meetings, I present a game which helps to sum up all the topics covered during the course. At each turn a child throws the dice and draws a card requiring them to say or to do something related to the lessons.*

space mission launches. These reports can give the opportunity to talk about several topics, from distant comets and downgraded planets to missions involving the mapping of the Milky Way. But they can also help to introduce concepts like gravity and the other forces acting in outer space or inside stars. Once again, the most important thing is to ease the explanations with little games and practical activities. You don't need great sophistication or complexity. Quite the contrary, simple is better. Obviously you cannot do accurate experiments, but it is interesting to notice how simple and common objects are useful for explanations of concepts that might seem difficult to demonstrate without complex laboratory tools.

Sometimes you might find yourself with a group of very knowledgeable children, with a rich background of information acquired from many sources, like books, visits to museums or even specific lessons at school. While in this case it might seem harder to meet their expectations, I was surprised to realise that in many cases it makes the task easier. Having been exposed to so much information often means that this information is stacked randomly in their memory, with no logic, causality or understanding of the basic principles. Moreover, the kinds of courses that led to this information being gathered at such a young age typically favour a passive approach, which implies that the children, with little possibility, or lacking the courage to ask for clarification, are left with a huge number of unanswered questions just waiting for a chance to be unleashed. The right approach in these cases, is just ask if there are any specific questions, be open and thorough, and the rest will flow naturally.

One problem I have faced is how to talk about topics that might be quite advanced without resorting to mathematics, providing understandable yet accurate explanations and at the same time keeping alive the attention of your group. It would be impossible to give a complete list of all the topics and the solutions that I have found in these two years, so I will try to give just one example which can show the general approach I always try to follow.

I was explaining the effect of gravitational lenses using some drawings and the spectacular images from the Hubble Space Telescope. At a certain point I was explaining that some of the background objects were quasars, so I was immediately asked what a quasar was. This provided the perfect opportunity to introduce other concepts that are far from the everyday experience.

In particular, the idea that quasars are "old" and that closer, and therefore younger, objects of the same kind such as nearby galaxies are very different from them, made it possible to understand that even in space things change with time and "grow old". From this starting point, always driven by questions, we went on to talk about the evolution of stars. In practice, we managed to modify the way in which the information flows from teacher to students. Instead of telling them about unrequested concepts that follow my line of reasoning, I explained the subjects that flowed naturally from their own unique curiosity and reasoning, an approach that cannot be used in books.

In this way the teaching experience that resulted was both easier and more effective, because the children were not forced to concentrate on subjects in which they were not interested, but rather my role was simply to facilitate their own paths of enquiry and ensure they had the information needed to answer their own burning questions.

Finally, the magic word is... fun

In an entertaining yet educational laboratory of astronomy fun is a must. When attention wanes or interest drops, perhaps because the children are coming from a long day at school, the magic question that teases the minds and raises smiles is: "Would you like to play?"

These words are always a hit. The topic of the game will obviously be an astronomical one, and if you can create games with a clear objective they will always be successful because everyone will want to try to reach the final goal. This is a fantastic way to revise the concepts seen in the previous lessons, but it is particularly important that such games can involve all participants with manual and visual activities. This is also a technique that suits atypical locations like toy shops where children may be more open to play and more confident that they are allowed to play than in a school or museum environment.

In one case, I wanted to try something daring: the discovery of the Hertzsprung–Russell (HR) diagram, an advanced subject typically addressed in university lectures, but presented as a game to a group of children where the oldest was just nine years old. In this way I managed to introduce the use of plots and scales, and even give a glimpse into logarithms. I selected a suitable stellar sample, with each star represented by a disc of paper. These discs, all with different dimensions, were then put inside a box from which the children had to pick them one by one. The properties of each particular star were written on the corresponding disc, and after reading them the child had to put the disc on a large sheet of paper marked with the axes of the HR diagram. In this way, star after star, the diagram emerged, and at the end, without giving further details, I encouraged them to try and analyse what they were seeing. At the end I gave them a smaller version of the diagram asking them to check whether all the stars were in the correct position.

This game, and others like it, demonstrate the advantage of taking astronomy out of the classroom and into a location associated not only with learning but with excitement and fun. The children are given the freedom to enjoy the process and the courage to ask questions, follow lines of enquiry that they may not even have known they had and to indulge their curiosity. It is a method that I will continue to use and which I hope others can also take something from.

Acknowledgements

I want to thank my family; their suggestions, their inventiveness, their time and technical resources have helped me to develop and to carry out these astronomical games.

Notes

[1] Free space simulation software Celestia: http://www.shatters.net/celestia/

Biography

Gabriella Bernardi was born two years after the landing of the first man on the Moon. She has a degree in Physics, a Masters in Scientific Communication, and she has been working for several years on the popularisation of astronomy and in scientific journalism. She is a member of the Union of Italian Scientific Journalists (UGIS) and the European Union of Science Journalists' Association (EUSJA). In 2007 she won the Voltolino prize for scientific popularisation. As an author she has written, in Italian, *Dov'è il cigno?* (2010; *Where is Cygnus?*); *Il cielo dimenticato in un baule* (2012; *The sky forgotten in a trunk*), a book for children about the female astronomers of the past; *La Galassia di Gaia* (2013; *Gaia's Galaxy*); and, most recently and available in English, *The Unforgotten Sisters-Female Astronomers and Scientists before Caroline Herschel* (Springer, 2016).

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