# 18

# Using sounds and sonifications for astronomy outreach

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**Abstract:** Good astronomy pictures, like those of the HST, play an important and well-known role in astronomy outreach, triggering curiosity and interest. This same aim can also be achieved by means of sounds. Here we present the use of astronomy-related sounds and data sonifications to be used in astronomy outreach. These sounds, which people are unlikely to hear in the normal course of things, are a good tool for stimulating interest when teaching astronomy. In our case, sounds are successfully used in "The sounds of science," a weekend science-dissemination program heard on the principal national radio station, Radio Nacional de España (RNE). But teachers can also easily make use of these sounds in the classroom, since only a simple cassette player is needed.

## 18.1 Introduction

This paper presents neither a teaching methodology nor a study program but simply a very simple tool easily used in the classroom. Because it is so easy to implement, its results are strikingly effective for provoking student interest. The tool involves the use of sounds and sonifications that are either of astronomical origin or related in some way to astronomy.

The power of beautiful astronomical images to trigger our curiosity and interest is well known. Attractive images provide good reinforcement for explanations of astronomical concepts. When people look at them, they find them beautiful, strange, curious, rare, spectacular – something they are unlikely to encounter in daily life. Images, therefore, are a good hook to attract people to astronomy in particular and to science in general. When looking at these images, many students, ask, "Is this really out there?" Several even think, "I would like to see that with my own eyes." A few may even say to themselves, "Wow, I would like to do something like that myself," and eventually become professional astronomers. In short, astronomical images are a very good outreach tool.

It turns out that sounds can play the same outreach role as astronomical images. Sounds of astronomical origin can be used very effectively for astronomy outreach. They are also a good tool to stimulate interest when teaching astronomy. These sounds are attractive in some cases because of their intrinsic beauty; in others, because of their exotic origin; and in general because they are sounds that people are unlikely ever to hear in the normal course of events.

On the other hand, people are growing so accustomed to – almost over-saturated by – pictures that they are at risk of finding them somewhat dull. Sounds thus provide an excellent alternative to images. In some cases, in fact, sounds are superior to images. For example, in the case of pulsars, the images are not very spectacular but the sounds are strangely attractive.

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Finally, although some astronomical images are newly available in Braille, in general blind people can be exposed to the wonders of astronomy more effectively through sound than through visuals.

## 18.2 Use in the classroom

Clearly, sounds are very easy to use in the classroom, as they require only a simple infrastructure: just a cassette player or, more recently, an mp3 player. What might be more difficult is for the teacher to obtain these sounds. Fortunately, in the Internet age, there are several sources. Both Altavista and Alltheweb have search engines for sounds. If you are patient, it is possible to find exactly what you are looking for. Some research centers are also making compilations of sounds related to their work. The excellent page "Space Audio", at the University of Iowa, lists radio recordings of sounds of many atmospheric and astronomical phenomena. As the trend continues to grow, more scientific and astronomical sounds will become available over the Internet.

An interesting alternative is to sonificate your own data – that is, transform your own research results into an audible format. Doing so will give the data a new and interesting dimension that can help you disseminate your research. Nowadays there are several programs available to facilitate this task. "Sonification Sandbox", for example, is a commercial Java multi-platform software, usable in almost any operative system. "Sounds of Space", software developed by the University of California at Berkeley, for Windows XP and Mac, can even help you to detect through audio some structures that would pass unperceived in a visual exam. The creators of the software "Sounds of Space" took data from satellites Helios-1 and 2 that measured the intensity of solar emission, passing frequency to musical tone and emission intensity to sound intensity, resulting in a very interesting piece of sound. And given that there were two satellites, the sound was in stereo!

Once you have the sounds, what do you do with them? There are different ways to use sounds during class time. The most obvious way is to use them for emphasizing or highlighting what you are explaining. For example, if you explain what an aurora is, you can conclude your exposition by saying, "And it sound like this," which undoubtedly will grab the students' attention. It might be better, in fact, to start with the sound, and only begin your explanation once you have the attention of the class. Or you can just play a game of "guess what this sound is." The limit is the imagination of the teacher.

## 18.3 Astronomical sources of sound

Using astronomical sounds is so surprising because we all know, including many students, that in space *there is no sound*. How, then, can we be talking about astronomical sounds? Where do they come from? This component of surprise is a good teaching tool in itself, which should should be taken into account for its challenge to expectation. In many cases, as the two previous examples of pulsars and aurorae showed, the sounds will be radio signals passed to sound. Radio transmission is one of the most productive sources of sounds, and you can find also radioemissions from black holes, lightning storms on Saturn, or ionization tracks from shooting stars, for instance.

But there are cases where the sounds are real. Sometimes there can be a direct record of sound, as when a shooting star crosses the sound barrier, and sometimes inaudible but real sounds can reconstructed, as in the case of sound waves crossing the solar surface: because of the vacuum of space, this sound does not reach Earth, but can be indirectly "recorded" by instruments, like the SOHO satellite, and reconstructed afterwards.

Other effective sounds for classroom use are not of direct astronomical origin but nonetheless support the explanation astronomical concepts. The sound of a train passing, for example, can help explain the Doppler effect and its relationship with astronomy. The music from Kepler's *Harmonices Mundi* represents the different speeds of orbital movement as notes, with each planet having a melody associated. A very fruitful source of sounds comes from the world of astronautics, including Neil Armstrong's remarks, audio from the Voyager disk, telemetry of Sputnik, etc.

## 18.4 Conclusion: it works!

The most important lesson we can give about the use of this tool is that we know it works. The authors of this paper have a successful radio program based on this tool, called "Los Sonidos de la Ciencia" – the sounds of science. It is a 10-minute-long program, aired at weekends for the past two years on the principal national radio station, Radio Nacional de España (RNE). The show has been a great success, earning first place among "best morning radio programs" in the Spanish version of the popular *ciao* listing (ciao.es), as well as first honorable mention for science dissemination in the national phase of "Science on Stage." Listeners write often to the program asking for more information about the concepts explained on the show. From their input we know that one of the most important components of the program is that they enjoy listening to those sounds that they would otherwise never hear. That is the key.

### Acknowledgments

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### Sources

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### Comments

**Unrecorded questioner**: Do you tell your audience the frequency of the sounds they have heard?

**Fernando J. Ballesteros**: Yes, and I recommend that others who use sound for astronomical teaching or outreach do so.

**Daniel Fischer**: The scientists turning plasma wave disks from the Voyagers into sound didn't do it for fun – they (esp. PI Dave Gurnett) actually *listen* to their disks to better understand the processes of plasma flowing around planets (in a similar pattern to the turbulent flow of water).