

Martian Science and Technology in the Research High School.

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Abstract

The project described is an initiative undertaken by the Pamplona Planetarium and high school students from several different institutions. The goal of the project was to construct and assemble a 1:4 scale replica of the Perseverance rover. This project was carried out over the course of a school year, with the participation of 12 students from 4 different institutions. Each institution was responsible for a different part of the model, and monthly sessions were held to discuss the progress and any challenges encountered. In addition to building the rover replica, each student also conducted their own small-scale scientific research on Mars and the context in which the Perseverance rover operates. This project appears to be a unique opportunity for high school students to engage in hands-on learning and teamwork, while also gaining a deeper understanding of Mars and the science behind the Perseverance mission. This can help to foster students' interest in science and technology, and may be a valuable experience that prepares them for future studies and careers in these fields.

1 Introduction

In June 2021, a collaboration agreement was established between the Pamplona Planetarium and several high schools institutes in order to promote an initiative called "Bachillerato I+". This type of research high school has been implemented in the institutes of Barañáin, Plaza de la Cruz, Ribera del Arga and Valle del Ebro, and constitutes an educational option within the high school aimed at students who are interested in delving into the different research methods and in the analysis of the problems of any investigation.

The rover replica construction project was carried out during a school year, with the participation of 12 students from 4 different institutes, with equal participation between male and female students. However, the total number reached by the project has been higher, due to the participation of the leading students in different outreach sessions within their own institutes. Each institute has been in charge of a different part of the model, and during this course there have been monthly sessions in which the work done and the difficulties encountered were shared. In addition to the construction of the rover, each student has carried out a scientific investigation about Mars and the context in which the Perseverance

rover is located. This is a project in which the students have participated very actively and in which both technological and scientific concepts of missions to Mars have been worked on.

2 Development of the project

The way of working has consisted of simulating the operation of NASA or another space agency, in the construction of these kind of vehicles, with the distribution of the different components between the different centers. The project has been articulated in monthly sessions divided between the technical and scientific fields, in which the students have shared the development of the parts for the assembly of the rover that they had assigned by institute, and the difficulties in their construction and/or acquisition. Also in these sessions, each student has exposed to the rest of the participants the details of the scientific topics that they are analyzing, such as the meteorology on Mars, geology, impact craters, polar caps, water on the planet, storms from dust etc. In the development of their scientific investigations, the students have been working with data from the missions to Mars, downloading the information from the public repositories of the PDS, processing the data and relating the results to their own investigations.

The rover model selected for the project is publicly available on the informative web space howtomechatronics.com and consists of the assembly of different parts made with 3D printers, installation of the vehicle's electronic system and programming and connection of the devices.

In total, more than 150 parts have been printed with 3D printers and the manufacturing of these parts was divided equally among the four institutes (Figure 1). This part of the project allowed the students to gain experience in this type of tool, since it was the first time for all the students that they had to get involved in the use of this type of tool. The students also made a 1:1 scale Perseverance rover wheel to compare with the wheels on our model and get an idea of the rover's actual dimensions.

3 Results

After 9 months of diligent work, the team successfully completed the construction of the replica of the Perseverance rover (Figure 2). However, the scientific research projects related to the project are currently ongoing, and will soon be presented and defended at their respective institutions. This multi-faceted project has been a valuable learning experience for the students involved, and we look forward to seeing the results of their research.

The rover is equipped with motors and electronic components that allow it to move across the terrain avoiding obstacles. It also has a camera that allows you to observe the situation from the rover's perspective. All these pieces of equipment can be handled and controlled with a radio control joystick.

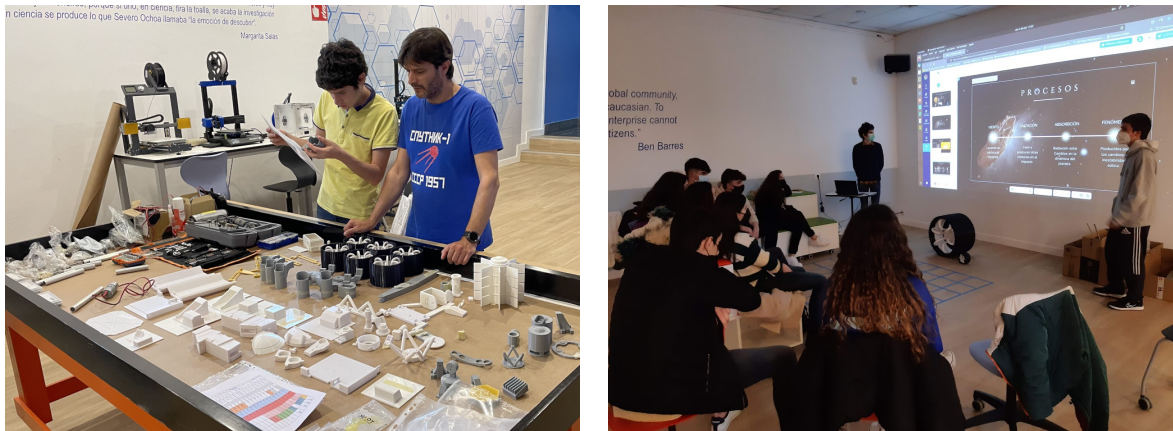


Figure 1: Two types of sessions in the project: The engineering sessions (left) ordering the more than 150 pieces made by the different institutes. The scientific sessions (right) with the presentation of the different topics to the rest of the students.

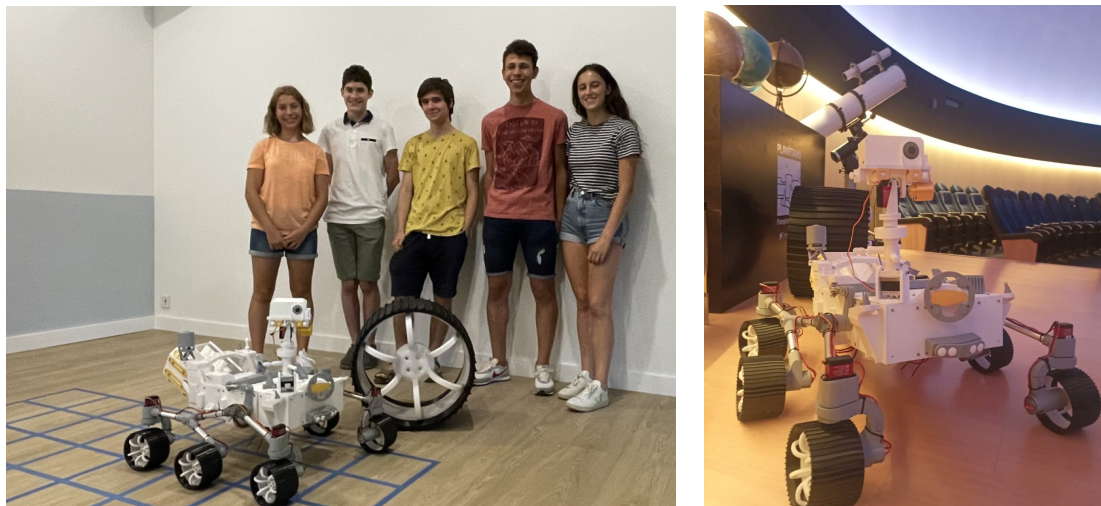


Figure 2: Final result of the construction of the rover model, which is currently on display at the Pamplona Planetarium.

4 Conclusions and Next Steps

Among the direct benefits focused on the students who have participated, we can highlight::

1. Hands-on learning experience for high school students.
2. Opportunity to apply technological and scientific concepts to a concrete project.
3. Collaborative teamwork among students from different institutes.

4. Development of deeper understanding of Mars and the Perseverance mission.
5. Enhancement of students' interest in science and technology.
6. Preparation for future studies and careers in these fields.
7. Positive impact on students' engagement and motivation.

We can conclude that this project in order to build a replica of the Perseverance rover has been successful in terms of engaging and motivating students, as well as providing a practical application of technological and scientific concepts. Additionally, the project has contributed to a deeper understanding of Mars and the Perseverance mission, and has fostered students' interest in science and technology. To which we must add that as a result of the project we have a replica of the Perseverance rover on which to continue working.

4.1 Next Steps

We have proposed to the students of the following course the possibility of including a robotic arm and a weather station in the rover.

The decision to continue the project and add a robotic arm to the front of the rover shows a long-term commitment to educational and practical learning for students. The addition of a robotic arm also offers the opportunity to continue exploring and experimenting with technologies and processes used in Mars exploration. Overall, this project seems to be a valuable initiative that benefits students and promotes their interest in science and technology.

In addition, there is the possibility of the inclusion of a weather station (similar to MEDA weahter station, [1]) inside the rover replica also offers the opportunity to address topics related to meteorology and climate change with students, which can help to increase their knowledge and interest in these important subjects. Overall, this project seems to be an excellent opportunity for students to gain practical skills and scientific knowledge while working on a collaborative and engaging project.

We highly encourage other schools to replicate this project. The construction and assembly of a replica of the Perseverance rover offers a unique and engaging learning opportunity for students, and allows them to apply technological and scientific concepts to a tangible project. Additionally, the project promotes collaboration among students from different schools, and encourages a deeper understanding of Mars and the Perseverance mission.

References

- [1] J. A. Rodriguez-Manfredi, M. de la Torre Juárez, & The MEDA team, *Space Sci Rev* 217, 48 (2021). <https://doi.org/10.1007/s11214-021-00816-9>