

OVERVIEW OF EDUCATIONAL APPROACH OF A CITIZEN SCIENCE PROGRAM FOR PLANETARY SCIENCES KNOWLEDGE Adriana Victoria Araujo Salcedo¹, Universidad Sergio Arboleda, Bogotá, Colombia; adriana.araujo02@usa.edu.co

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Introduction: In the last decade, a deep understanding of minor solar system objects has been the main interest in planetary sciences research. Planetary science is the perfect definition for an array of scientific disciplines that together try to seek answers about how the solar system formed. Around this latter, until now, thanks to the SENTRY the Near Earth Objects coordination center from ESA, we know that there are, close to 31441 near-earth asteroids (NEA). On the other hand, objects causing fireballs are usually not large enough to survive passage through the Earth's atmosphere intact. Likewise, around the latter there is a relevant topic, which is that sometimes it is possible to recover fragments of meteorites on the ground, allowing research on such impactors. All around NEO, fireballs, meteorite events, and impact events of some of these objects on Earth lead both, the general public and scientific community alike to ask, how often are such impacts on the Earth, and what is the hazardous level to the earth? One of the challenges with addressing these questions is communicating under the expertise and the research basis of these topics. Through research, education, and outreach project in Colombia at the University Sergio Arboleda named SAROS [1, 2], we have developed a STEM and one citizen science program for searching new asteroids that provide high-quality astronomical data to citizen scientists around Colombia. These citizen scientists can make original astronomical discoveries and participate in hands-on astronomy programs not only for the University but for the general community as well. This work aims to give the correct understanding of such objects of the solar system, but also to teach how these objects are essential for the complete understanding of the birth of life on our planet, as well as the knowledge of which of them have a representative hazardous level for us on Earth [3]

Outreach in Astronomy and planetary sciences: SAROS is an interdisciplinary student group in the Mathematics undergraduate program at Sergio Arboleda University. This group is dedicated to studying physics, mathematics, and astronomy. We develop projects for research, education, and outreach in Astronomy and planetary sciences. In Saros, since 2020 we have created The Artemis research project based on the search

for asteroids, taking into account the world problem regarding the real possibility of a potentially dangerous asteroid colliding with the earth. To understand this phenomenon, we must be aware of the existence of smaller bodies in the solar system close to our planet, also called Near Earth Objects (NEO). Among the NEOs, we can classify some asteroids into three groups; Amor, Apollo, and Aten, where the latter are the most interesting. The IASC International Astronomical Search Collaboration (IASC) is supported and endorsed by Hardin Simmons University, NASA, and the Hawaiian Institute of Astronomy, among 40 other collaborators from different cities generating citizen science and planetary defense programs. That is why the Artemis asteroid search group, which is part of the SAROS Mathematics and Astronomy research hotbed, aims to address this problem by participating in asteroid search campaigns and promoting citizen science in different scenarios inside and outside the University. It is thus that through the use of the free software Astrométrica, and from the analysis of images of certain sectors of the field of view of the telescope, it has been possible to bring scientific data closer to the community in general, establishing a whole educational chain on topics that seem to be far away of the reach of the citizen and achieving real contributions to science like the provisional asteroid 2021VR34 discovered by Artemis during one of the 2021 campaigns [1].

Colombia Search for Asteroids: A citizen science program: Citizen sciences programs are scenarios that provide high-quality information for people that are not necessarily from the academy community. There are many programs, specifically in planetary sciences, for example, searching meteorite samples or like the program develop for IASC.

This organization is a **citizen science program** that provides high-quality astronomical data to citizen scientists around the world. In Colombia, several Universities, institutes, and scientific organizations like the Universidad Sergio Arboleda, and the Astronomical Observatory of the Universidad Distrital in Bogotá have developed this with the support of the IAU Office of Astronomy for Education in Colombia ¹, and have carried this experience around the whole country. These citizen sci-

¹<https://accefyn.com/microsites/nodos/astroco/oaecolombia/>

entists can make original astronomical discoveries and participate in hands-on astronomy. We organize the campaigns in 75 groups, in Fig 1 is presented how the campaigns are organized

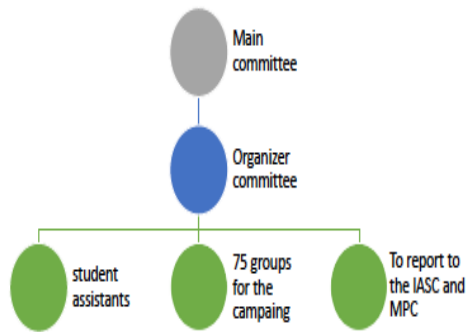


Figure 1: Organization of the citizen program

Provisional asteroids for Colombian’s campaigns 2021-2022: A preliminary detection is the first, original observation of a new asteroid. The asteroid must be observed a second time within the next 7-10 days. If it is, then the detection is changed to provisional status by the Minor Planet Center (MPC). Asteroid discoveries with provisional status are maintained in the MPC database for many years until there have been a sufficient number of observations to determine the orbit fully. During the campaigns in 2021 and 2022, many provisional has been found by Colombian citizen scientists. The data is provided by the IASC, and the proper confirmation is given by the Minor Planet Center (MPC). The provisional discoveries for the Colombian teams at these campings are presented in the following

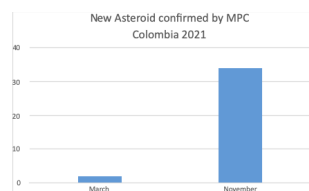


Figure 2: Provisional for 2021 campings

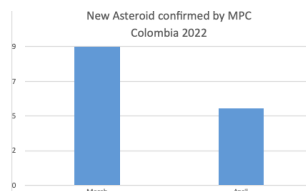


Figure 3: Provisional for 2022 campings

In the latter graphics, we can evaluate the provisional asteroids confirmed by Colombian citizens. Most of them are from the main belt region with a confirmed orbit. It is expected that in the future time, these asteroids can have a stable orbit and finally be named.

Conclusion: Citizen sciences programs are scenarios that provide high-quality information for people that are not necessarily from the academy community. One of the challenges with addressing topics around planetary sciences is communicating under the expertise and the research basis of these topics. Through research, education, and outreach project in Colombia, we proved that this citizen science program provides high-quality tools for the development of knowledge in planetary sciences and astronomy as well. Also, It is possible to list the following

1. The students and general community have increased their knowledge of minor planets’ solar system objects.
2. School teachers have incorporated the activities into their classes.
3. More students have been motivated to study STEM careers.

Is expected to increase the number of participants from different regions of the country. Ensuring a very good understanding of the general community and interest in planetary sciences topics. From the universities and the astronomical observatories that manage this citizen program, the results listed before are very fine proof that as more as we improve this kind of activity more people are going to be linked with the scientific community.

References: [1] Universidad Sergio Arboleda (November 4 2022) <http://surl.li/fortv>. [2] A. Araujo (2022) in *METEORITICS & PLANETARY SCIENCE* vol. 57 WILEY 111 RIVER ST, HOBOKEN 07030-5774, NJ USA. [3] J. Roa, et al. (2021) *arXiv preprint arXiv:210803201*.