

OBAFOG rockets and the dispersal of native seeds: an interdisciplinary proposal

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Abstract. The current climate emergency highlights the importance of discussing environmental education actions in basic education. In this context, astronomy, with its interdisciplinary and motivational potential, stands out as a strategy capable of arousing interest and engagement. The multi-course character of the UTFPR Astronomy Club (Clube de Astronomia da UTFPR, CAUTEC) enables the development of multidisciplinary extension activities, such as the one developed last year: the project aimed at sowing native species of the Atlantic Forest using PET bottle rockets, propelled by water and compressed air, taking advantage of the model and launch apparatus of Level 3 of the Brazilian Rocket Olympics (Olimpíada Brasileira de Foguetes, OBAFOG). In this study, we describe the activity in detail, with the aim of enabling its reproduction by other educators and institutions. The activities took place in 4-hour meetings with elementary school students from two schools — one private, in Curitiba (PR), and one public, in the rural area of Lapa (PR) — as well as workshops during the 21st Agroecology Journey and at the 14th State Meeting of Sem Terrinha Children, in Curitiba (PR). We aim to encourage reflection on environmental preservation and recognition of species from the predominant biome in Paraná. To do this, we adapted the rockets, adding structures to disperse pitanga and ipê-amarelo seeds. As support, a folder was created with information on natural dispersion by animals and how to use rockets for this task. The activity generated questions and comments, and we noticed different levels of understanding among participants; students from rural areas readily identified the two species. We believe that the activity achieves its motivational goal and can be improved and replicated, adapting to different species and regional contexts. This is evidenced by the broad national participation in OBAFOG, involving institutions and students from all regions of Brazil. As a future step, we propose, in contexts with a greater course load, using this activity as a motivating topic for experiments with plants in microgravity and the cultivation and distribution of food on other planets and on Earth.

Resumo. A atual emergência climática evidencia a importância de discutir ações de educação ambiental no ensino básico. Neste contexto, a astronomia, com potencial interdisciplinar e motivador, apresenta-se como estratégia capaz de despertar interesse e engajamento. O caráter multicurso do Clube de Astronomia da UTFPR (CAUTEC) possibilita o desenvolvimento de atividades extensionistas multidisciplinares, como o trabalho desenvolvido no último ano: um projeto com o objetivo de semear espécies nativas da Mata Atlântica utilizando foguetes de garrafa PET, com propulsão a água e ar comprimido, aproveitando o modelo e aparatos de lançamento do Nível 3 da Olimpíada Brasileira de Foguetes (OBAFOG). Neste trabalho, descrevemos em detalhes a atividade, visando sua reprodutibilidade por outros educadores e instituições. As ações ocorreram, em encontros únicos de 4 horas, com alunos do ensino fundamental de duas escolas – uma privada, em Curitiba (PR) e outra pública na zona rural da Lapa (PR), além de oficinas na 21^a Jornada de Agroecologia e no 14^o Encontro das Crianças Sem Terrinha do Paraná, em Curitiba (PR). Buscamos incentivar a reflexão sobre preservação ambiental e o reconhecimento de espécies do bioma predominante no Paraná. Para isso, adaptamos os foguetes, adicionando estruturas para dispersar sementes de pitanga e ipê amarelo. Como apoio, foi confeccionado um folder com informações sobre a dispersão natural por animais e como usar foguetes nessa tarefa. A atividade gerou dúvidas e comentários, e percebemos diferentes níveis de entendimento entre participantes; alunos do meio rural prontamente identificaram as mudas das duas espécies. Consideramos que a atividade cumpre seu objetivo motivador e pode ser aperfeiçoada e reproduzida, adaptando-se a diferentes espécies e contextos regionais. Isto é evidenciado pelo alcance da OBAFOG, que envolve instituições e estudantes pelo país todo. Como passo futuro, propomos, em contextos com maior carga horária, usar essa atividade como tema motivador sobre experimentos com plantas em microgravidade e o cultivo e distribuição de alimentos em outros planetas e na Terra.

Keywords. Teaching of Astronomy.

1. Introduction

The current climate emergency highlights the importance of discussing environmental education initiatives in basic education. It is important for students to develop practical and theoretical knowledge in this area from an early age, identifying, for example, how human activities affect the various Brazilian biomes.

In Paraná, the Atlantic Forest is the predominant biome. This tropical rainforest extends across several South American countries and seventeen Brazilian states. It has a great diversity of flora and fauna, with many endemic species, i.e., species that are typical of the Atlantic Forest and do not exist anywhere else on the planet. Unfortunately, human actions such as burning, il-

legal logging, hunting, deforestation for agriculture and urban expansion have caused great devastation, and today only a small percentage of the original Atlantic Forest area remains (Tabarelli et al. (2005)). Therefore, restoring and preserving the remaining ecosystems is essential for maintaining biodiversity and natural resources.

In order to stimulate greater awareness regarding the preservation of this biome, we highlight the possibility of combining environmental education with other areas of knowledge. Astronomy, for example, has great interdisciplinary and motivational potential (Langhi & Nardi, 2014) and is capable of stimulating interest and engagement when associated with the teaching of other sciences. The multi-course nature of the Astronomy Club

of the Universidade Tecnológica Federal do Paraná (CAUTEC) enables the development of multidisciplinary extension activities.

One of the projects developed by CAUTEC in 2024 aimed to adapt PET bottle rockets, propelled by water and compressed air, to disperse seeds of native Atlantic Forest species. The activities were carried out on four occasions: at two schools, at the 21st Agroecology Journey and at the 14th State Meeting of Sem Terrinha Children. In this study, we describe the actions with a goal of making them reproducible by other educators and institutions.

2. Procedures

In this section, we describe the preparation for the activities (choosing and collecting seeds, testing different rocket models) and the actions carried out in schools and at the Agroecology Journey and at the State Meeting of Sem Terrinha Children.

2.1. Preparing and testing

Seed collection depends heavily on the ripening season of each species, and their availability depends on the region and climate (Schäffer et al. (2024)). In this first version of the project, developed in October and November in Curitiba (PR), we used seeds from pitanga and ipê trees, plants that are typical of the Atlantic Forest and easily found. Fig. 1 shows the fruits and seeds of the pitanga and ipê-amarelo trees.

We also did germination tests on the seeds we selected to see if they were viable and how long they would take to grow. They germinate in less than a month.

After collecting and preparing the seeds, we began testing different rocket models for dispersion. We were inspired by similar projects, since the idea of reforestation with eco-friendly rockets is not new (e.g., Câmara (2024)), but we needed a model that was easy to build, since the activity would be carried out with elementary school students. Therefore, we used the model and launch apparatus¹ from Level 3 of the Olimpíada Brasileira de Foguetes (OBAFOG).

Based on tests with different models, we concluded that the best seed dispersion occurs when the rocket has wings glued at an angle. This configuration promotes rotation during flight, thus dispersing more seeds. For storage, we use tubes attached to the body of the rocket and open at both ends. In the model with curved tubes, the curvature keeps the seeds inside while the rocket is at rest; during flight, the rotational movement causes them to slide out and be released. The model with straight tubes also worked. The different prototypes are illustrated in Fig. 2.

2.2. Activities

After choosing the rocket prototypes, we carried out activities with elementary school students from two schools — one private, in Curitiba (PR), and the other public, in the rural area of Lapa (PR) — as well as workshops during Sem Terrinha Meeting and Agroecology Journey, both in Curitiba (PR). The activities lasted about four hours each.

At the Sem Terrinha Meeting and the Agroecology Journey, the workshops were designed to foster a critical perspective on technology applied to agriculture. Leveraging the lived experiences of the children in rural environments, we aimed to integrate reforestation practices with their daily reality in the fields. The



FIGURE 1. Top panel: Pitanga is a small fruit that turns reddish when ripe, with a small, roughly spherical seed in the middle. It is widely consumed by birds, which are the main natural dispersers of these seeds. Pitanga seeds were washed and dried after collecting the fruits that had fallen to the ground. Bottom panel: Ipê fruits are pods filled with light seeds. When they dry, the pods open and release the seeds, which are scattered by the wind. The ipê-amarelo seeds were separated from the pod and stored after it opened naturally.



FIGURE 2. Rockets used in the testing phase, based on the OBAFOG level 3 model. On the left, the model with straight tubes, and on the right, the model with curved tubes. A whole PET bottle forms the body and another cut bottle is positioned as the tip of the rocket. Small tubes, made from the remaining part of the cut bottle, store the seeds. The three wings are made of cardboard.

¹ https://www.serra.ifes.edu.br/images/stories/como_construir_o_foguete_MOBFOG_DE_2019.pdf

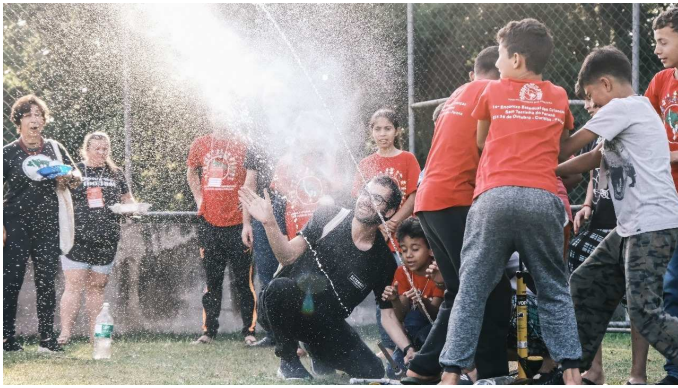


FIGURE 3. Launching rockets at the Sem Terrinha Meeting.

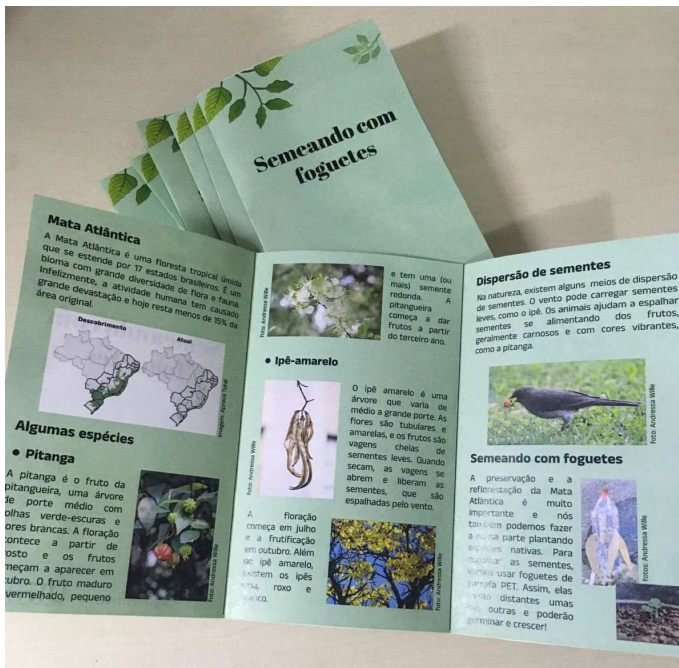


FIGURE 4. Folders with information about the Atlantic Forest, the species used in the activity, and natural dispersers. Since the focus of the activities was on making and launching rockets, we opted for simpler and more succinct support material.

pedagogical sequence began with a classification activity, where children analyzed images to distinguish technological from non-technological elements. This was followed by a creative session where they illustrated potential technological solutions for planting. The activities culminated in the construction of PET bottle rockets, serving as functional prototypes for aerial seed dispersal, as shown in Fig. 3.

At the schools, we aimed to encourage reflection on environmental preservation and recognition of the pitanga and ipê-amarelo trees. We showed the students the seeds and also the plants after a month of germination. As theoretical material, a folder was created, shown in Fig. 4, with information on natural dispersal by animals and how to use rockets for this task.

Fig. 5 shows the students were organized into small groups to make the rockets, after the initial discussion. The launches took place in outdoor areas of the schools, covered with grass, as shown in Fig. 6. We requested the students to collect the rockets after each launch, preventing the plastic material from being left in the environment. They also checked if there were any seeds left in the tubes that had not been dispersed.



FIGURE 5. Students building PET bottle rockets at the private school in Curitiba.



FIGURE 6. Launching rockets at a rural school in Lapa (PR).

3. Results

The proposed activities raised questions and comments about both the rockets and the seeds. We also noticed different levels of understanding among the participants: when we showed the germinated plants to start the discussion, the students from rural areas quickly identified the two species, while those from the school in Curitiba needed some hints to recognize which seeds had been planted. On the other hand, everyone showed interest and dedication in building the rockets, with our help.

In addition to the involvement observed during the activities, the project also resulted in the development of a guide² for other extension groups or teachers who wish to replicate the actions, including detailed guidelines and the relationship with the skills of the Brazilian Base Nacional Comum Curricular (BNCC) and UN's Sustainable Development Goals (SDGs).

4. Conclusions

We found that the activities achieved their motivational goal and can be improved and replicated, adapting the species used for dispersal to different regional contexts. In addition, in future activities, the dispersed seeds can be monitored to verify their germination and development.

We highlight the great interest of participants in building or modifying PET bottle rockets, reinforced by the wide reach of OBAFOG, which engages schools and students across the country. We believe that this project promoted interdisciplinarity between botanics and homemade rocket construction, enriching CAUTEC's actions and contributing to the awareness of students and communities in Paraná about biodiversity and the preservation of the Atlantic Forest.

As a future step, we propose that, in contexts with a greater course load, this activity be used as a starting point to further expand the connection between biology and astronomy, discussing, for example, experiments with plants in microgravity (such as those carried out on the International Space Station), space exploration, and food cultivation on other planets and here on Earth.

References

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Tabarelli, M., Pinto, L. P., Silva, J. M., Hirota, M., Bede, L., 2005, *Megadiversidade*, 1, 132.

² https://drive.google.com/file/d/1hDiNQPg124XnNBuKsn0jCe8bVUTB79_1/view?usp=sharing