

UNLOCKING SCIENCE FOR ALL: FOSTERING COMMUNITY EMPOWERMENT THROUGH EUROPEAN RESEARCHERS' NIGHT IN RURAL TERRITORIES OF PORTUGAL

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Abstract

Many communities remain on the fringes of scientific engagement, particularly in rural areas such as Armamar and Resende, in Portugal, where access to science is a distant dream. Situated in Portugal's interior, these communities confront distinctive challenges, including diminishing populations, an aging demographic, and geographical remoteness from universities and scientific institutions. Consequently, there are few opportunities for contacting with science and scientists. This work explores how European Researchers' Night (ERN), a Europe-wide celebration of science, defied tradition by tackling rural landscapes, particularly the villages of Armamar and Resende, on September 29th, 2023. The event attracts each year more than 1.5 million participants all over Europe, but it typically thrives in urban settings, which benefit from strong institutional and academic support, and Portugal is not an exception.

Recognizing the potential for bridging the science gap in these environments, alliances with local and national partners were established, including Municipalities of Armamar and Resende, the school clusters of Resende and Gomes Teixeira (in Armamar), Gomes Teixeira Science Academy (GOMA), Os Afonsinhos (Youth Soccer School), Academia and ERN SCIEVER Consortium - University of Coimbra.

This resulted in two exceptional ERN events, one held in Armamar and the other in Resende, notably emphasising these locations' unique rural contexts. Their primary focus was decentralising science, promoting equal access and making science accessible to all. These two events collectively drew participation from over 250 attendees representing various age groups. This approach also involved the efforts of 33 researchers, a substantial number of whom are native from these communities. These researchers were actively engaged in outreach activities encompassing hands-on experiments, flash talks and interactive sessions, all designed to render intricate scientific concepts comprehensible to non-specialist audiences. Moreover, the ERN served as a platform for these researchers to enhance their science communication skills, through a specialised workshop supporting their abilities to effectively communicate scientific topics to non-specialized audiences. One of the most remarkable moments of these initiatives was the synergy created between over 55 secondary students from the two public schools and the researchers through the "Adopt a Scientist" program. This initiative allowed students to interact directly with scientists, contributing as volunteers in organising ERN, demonstrating their commitment to science and the event with the aim to deepen their interest in various science fields.

Given the scale of the event, the evaluation process was primarily carried out in Armamar. Results from this assessment exhibited resoundingly favorable outcomes. The majority of participants expressed an increased desire to explore science (98%), an increase in their awareness that their communities were home to many scientists (89%), an understanding of science's potential to address local issues (93%), and an eagerness to collaborate with scientists as active citizens (97%).

The European Researchers' Night in Armamar and Resende was a testament to equal access, opportunities and inspiration. This journey illustrates the transformative potential of community involvement and the pivotal role of science in sculpting a brighter future, regardless of where we call home.

Keywords: Public engagement, Rural territories, Science access, Equity, Community empowerment, European Researchers' Night.

1 INTRODUCTION

A flagship initiative of the European Union's, European Researchers' Night (ERN) is an annual pan-European event devoted to public engagement with research. It was first held in 2005 and now occurs in over 400 cities across Europe. The initiative aims to bring researchers closer to the citizens, raise public awareness and interest in science, and strengthen the relationship between science and European society [1].

The aim of the program, as defined in the European Commission's Horizon Work Programme, is to increase awareness of "research and innovation activities, with a view to supporting the public recognition of researchers, creating an understanding of the impact of researchers' work on citizen's daily life, and encouraging young people to embark on scientific careers" [2]. In other words, the program aims to facilitate closer collaboration between researchers and European citizens, promoting the exchange of ideas and research through engaging and entertaining means. European Researchers' Night offers a variety of science- and art-themed activities, such as live demonstrations, hands-on experiments, science shows, simulations, debates, games, competitions, quizzes, theatre, performances, art installations, guided tours of research labs, talks, citizen debates, panel discussions, workshops and other forms of engagement [3]. The European Commission proposes that a combination of education and entertainment is the most effective way to engage with people, regardless of their scientific background [2, 4].

Major urban centres in Portugal, including Lisbon, Porto, Coimbra, Braga, Évora and Faro, have consistently hosted ERN events since its inception. Thousands of records in archives and reports provide evidence of this [5-10]. ERN events promote a diverse and enriching experience, transforming university campuses, science centres (where they exist) and historic city centres into vibrant stages for a wide range of engaging activities. However, the transformative potential of ERN could be extended beyond urban areas.

In rural areas, where the population is declining and ageing and where there is considerable distance from academic institutions or science hubs, initiatives like the ERN could have a transformative effect, breaking down the above-mentioned barriers and bringing science to areas where it is not easily accessible.

This study explores ERN's unprecedented path into Portugal's rural territories, specifically in the Armamar and Resende villages, on September 29th, 2023. ERN's initiative in these remote communities demonstrates a commitment to decentralising science. It aims to facilitate and encourage interaction between researchers and the local population, ensuring equal access to scientific knowledge regardless of geographical constraints. In rural areas, ERN also aims to promote local researchers and disseminate local research, fostering a sense of belonging and sparking interest and appreciation for science within the community.

This article presents the first evidence of the European Researchers' Night initiative, strategically designed for rural areas of Portugal. It serves as a comprehensive guide and sets a precedent for best practices in organising future similar initiatives in rural settings. It also presents evidence supporting the effectiveness of these practices. Our findings highlight the impact of these initiatives as catalysts for transformative changes that are community-driven and in establishing enduring connections between local communities and scientists.

2 METHODOLOGY

2.1 European Researchers' Night in rural contexts

The ERN events were executed differently in each location due to their distinctive characteristics. This section briefly overviews the dynamics that shaped the events in the two rural contexts: Armamar and Resende.

2.1.1 *Armamar context*

The 2023 Armamar ERN event occurred at the Centro Interpretativo da Mulher Duriense (Douro Women's Interpretive Centre), a newly opened museum located in the town centre. Both indoor and outdoor spaces were used to accommodate the activities. The event, which ran from 6 pm to 10 pm, included different activities such as science stations, live and hands-on experiments, games, flash talks and museum visits for participants of all ages.

The success of the project was largely due to the formation of strategic alliances with local and national partners, including the municipalities of Armamar, the Agrupamento de Escolas Gomes Teixeira

(Armamar school cluster, AEGT), the Science Academy - GOMA and the ERN at the University of Coimbra, within the framework of the SCIEVER project [11].

2.1.2 Resende context

In Resende, the Museu Municipal de Resende (Resende's Municipal Museum) and the Praça 25 de Abril (April 25th Square) located in the historic centre, hosted the 2023 Resende ERN. The event ran from 7 pm to 10.30 pm. It is worth noting that the event coincided with the municipal holiday and the biggest municipal celebration – '*Labareda*'.

The ERN program included activities such as science stations and scientist speed dating, which engaged participants of all ages. Collaboration with local and national partners, including the Municipality of Resende, the school cluster, the youth organisation Afonsinhos, and the University of Aveiro through CIDTFF - Research Centre on Didactics and Technology in the Education of Trainers, played a vital role in the success of the event.

Armamar and Resende's ERN were held as free and public festivals. They involved the active participation of dozens of researchers, many of whom are native to these communities. These researchers acted as ambassadors for their respective disciplines and carried out hands-on experiments designed to simplify complex scientific concepts for a non-specialist audience. Both events heavily rely on volunteer staff, including local students, municipal and school staff. In Armamar the prevention team of Armamar Fire Department and the nursing team of the Armamar Health Centre also play a crucial role. The event's management was noteworthy for the voluntary involvement of three young graduates who were former students at the AEGT school cluster - Armamar. Local scientists, intimately connected to the territories, provided a unique local perspective to organising the events.

2.2 Outreach strategy and format

In order to ensure a coherent and targeted approach to engaging researchers, addressing their communication challenges and enhancing their engagement with audiences during the ERN events in rural areas, the outreach strategy included several key steps.

2.2.1 Diagnosis and researchers outreach

Contact points of researchers from the regions were compiled in the first phase. Potential researchers were identified and invited directly to the event, with a detailed explanation of the objectives and expected impact. At this step, particular care was taken to engage diverse researchers in terms of their gender, disciplinary field, ages and career stages and institutions, including researchers working in academia, in private companies and in NGOs.

2.2.2 Acceptance and communication

Upon acceptance, researchers received clear event instructions via email and were invited to complete a participation form. The form asked researchers to indicate audience preferences, format and type of activities, duration, theme, materials and support or specific needs during the event, number of researchers involved in each activity, and interest in attending a science communication workshop for non-expert audiences. Individual telephone conversations were then held with each researcher to tailor their activities to the non-specialist audience and the event's broad theme, 'Science for all: sustainable and inclusion,' to address any concerns or uncertainties.

2.2.3 Capacity building and communication workshop

Additionally, a capacity-building and communication workshop was held. An online workshop was organised to address the challenges researchers face in aligning their activities with non-specialist audiences. The workshop, which lasted for two hours, focused on science communication for non-specialised audiences. It aimed to enhance researchers' skills and confidence in public engagement.

2.2.4 Local cultural engagement visit

In collaboration with Armamar's Municipality, an additional cultural engagement component was introduced for ERN-Armamar. Before starting the ERN activities, the researchers were invited to participate in the village's guided cultural walking tour. The tour, led by a knowledgeable guide, provided historical insights into the town's landmarks and overall history. In Resende, as all the researchers were local and given the municipal holiday with a celebration held on that day, this activity was not implemented.

2.3 'Adopt a Scientist' program

The 'Adopt a Scientist' program was integrated into the ERN methodology and allowed the creation of a strong link between secondary school students and researchers.

Secondary school students were approached in close collaboration with school clusters, particularly through the GOMA program in Armamar. The ERN objectives and the opportunity to interact with researchers during the event were explained explicitly. Interested students formalised their participation by filling out an online form, indicating their preferences for scientists in order of priority. The online form also offers an option for students who do not wish to participate in the 'Adopt a Scientist' program but would like to volunteer to support the event organisation. Researchers were also contacted for the 'Adopt a Researcher' activity and gave their explicit consent for students to accompany them during the ERN.

2.3.1 Pre-Event briefing

An online meeting was held in the week before the ERN with all registered students, whether volunteers or participants in the 'Adopt a Scientist' program. During the meeting, the steps and procedures for the ERN were outlined, and a detailed grid of roles and functions was shared. This allowed each student to review their schedule, assigned tasks and the researcher they were adopting. On ERN day, all students were well-informed about their roles and procedures

2.4 Event information dissemination

Local communities in Armamar and Resende were informed directly through village announcements, using existing networks such as local schools, NGOs and municipal channels. In addition, a strategic dissemination plan was executed through social media platforms, with active collaboration from the participating schools and municipal entities.

Comprehensive information on the agenda, program details, and logistical guidance for setting up science stations or other activities that needed to be pre-installed was provided to participating researchers as the event date approached. This proactive communication aimed to streamline the preparation process and ensure a seamless execution of activities on the day of the event.

In Armamar, a participant-oriented approach was adopted. There, each participant was provided with a map that outlined the event's agenda and specific details, making it easy to navigate and participate in various activities. This on-site distribution of information helped to keep the audience well-informed and engaged.

2.5 Assessment and Evaluation: participants feedback questionnaire

Due to the unique scale of the event assessment and evaluation only includes the Armamar ERN participants.

As part of the process of assessing and evaluating the ERN, participants were asked to complete a short questionnaire, after leaving the venue, designed to measure the impact and impression of the event on them. The form contained four claims relative to which the respondents were asked to rate their level of agreement on a scale of 1 (strongly disagree) to 5 (strongly agree).

The claims were:

- ERN Armamar made me want to learn more about science.
- ERN Armamar made me realise that Armamar is the hometown of many scientists.
- ERN Armamar made me realise that science can help solve problems in Armamar.
- ERN Armamar helped me realise that, as a citizen, I can collaborate with scientists.

2.5.1 Data Analysis

Descriptive statistics of the data collected from evaluation to the community was performed using Microsoft Excel aimed to provide a general understanding of how rural communities experienced and perceived the ERN.

3 RESULTS

3.1 European Researchers' Night in rural contexts

The European Researchers' Night events in Armamar and Resende successfully engaged a diverse audience, with over 250 attendees ranging in age from 4 to over 70 years old. From the N=33 researchers actively involved in ERN, 26 (78.8%) researchers participated in Armamar and 7 (21.1%) in Resende, with 15 (45.5%) native from these communities. Table 1 provides a detailed summary of the different ERN activities, including their areas, topics and the number of researchers involved.

Table 1. Activities in ERN Armamar and Resende, categorised by discipline and theme, along with the number of researchers involved per area.

<i>Researchers Involved (number)</i>	<i>Area/Discipline</i>	<i>Theme</i>
N=13	Microbiology	Health sustainability - can nature provide us with a solution?
		Combating resistance: an evolutionary game
		MicroMundo Project
		Myth Hunter
		Molecular gastronomy: art on the table!
		Food waste: let's avoid it!
		SuperPhages
		Aquatic Microbiology
N=1	Food Science	Food sustainability - food science for all
N=2	Natural Heritage Management and Conservation	The owl, the farmer's best friend
		Ornithology
N=3	Chemistry	Wastewater purification filters
		Chemistry in a glass of wine
		Organometallic Chemistry in Society
N=2	Materials Science	Materials for a more sustainable future
N=1	Renewable Energy	Photovoltaic panels with third generation solar cells
N=1	Biophysics and Nanomedicine	Sunscreen, skin and sea-friendly
N=1	Regenerative Medicine	Regenerative cell therapies
N=1	Astrophysics	Are there other Earths in the Universe?
N=1	Artificial Intelligence	Artificial Intelligence Applications
N=1	Computer Graphics	Sustainable enjoyment of cultural heritage - Virtual Reality
N=2	Sports Sciences	Science in(to) sports
		Who is the strongest at the party? Who is the healthiest in the party?
N=1	Education Sciences	Evolution in societal problems
N=3	Social Sciences	"Cientista regressa à escola" game - <i>Native Scientists</i> program
		Local success experiences: "Voices of Folgosa - rescuing history through orality
		Science and Inclusion

Our analysis of the demographic composition of participating scientists shows a balanced gender representation. Out of the 33 scientists engaged, 18 identified as female (54.5%) and 15 identified as male (45.5%). This balanced representation highlights our commitment to promoting inclusivity and diversity in science engagement initiatives.

The researchers represented 12 different institutions/companies, four researchers working in four private companies; three researchers working in two NGOs, seven researchers from one private

university, two researchers from two polytechnic institutes and seventeen researchers coming from six public universities five of which were Portuguese.

The ERN Armamar and Resende events presented a diverse range of scientific disciplines and themes, enabling participants to engage with various branches of science. The topics covered included Microbiology (including health, food and aquatic microbiology); Chemistry (including organometallic and environmental chemistry); Biology and natural heritage management and conservation; Materials Science; Renewable Energy; Food Science; Sports Sciences; Social Sciences (including science communication; sociology and science and inclusion); Biophysics and Nanomedicine; Regenerative Medicine; Astrophysics; Education Sciences; Computer Graphics and Artificial Intelligence.

The range of activity formats contributed significantly to the dynamic nature of the events. These formats included Flash Talks (participated by 21.2% of the researchers), Science Stations with hands-on experiments, interactive games and practical demonstrations (participated by 60.6% of the researchers) and a Science Speed Dating session (participated by 18.2% of the researchers).

The diversity of topics and activity formats was crucial to achieving the overall objectives of the ERN. We aimed to increase engagement by creating an inclusive environment that caters to the preferences and interests of a broad audience, offering participants different ways to engage with science based on their preferences and interests, and facilitating meaningful discussions to personalise the science experience, breaking down traditional barriers between scientists and the public.

3.2 European Researchers' Night 'Adopt a Scientist' program

The ERN events included an innovative 'Adopt a Scientist' program, actively engaging over 55 secondary students. It aimed to foster lasting connections between the scientific community and the Armamar and Resende communities, increasing these communities' scientific capital, maximising scientific literacy promotion and deepening students' interests in various scientific disciplines. This initiative was developed in collaboration with local schools and involved secondary students in the organisation of ERN. The students' unexpected enthusiasm and commitment exceeded all expectations and enabled their multifaceted involvement as integral volunteers. The responsibilities of the individuals extended beyond conventional event logistics. They not only received and directed researchers to their respective science stations but also assisted participants in navigating through the various scientific stations and were involved in the event evaluation process. The involvement of student volunteers also provided them with a unique opportunity to participate directly in the event's activities, such as supporting researchers at science stations and interacting with researchers by asking questions. This sharing of knowledge and enthusiasm not only improved their overall experience but also demonstrated the potential of community-driven initiatives in establishing lasting connections between science and society. It emphasised the crucial role of local engagement in the success of ERN events in these particular contexts. In addition, it is believed that the sense of belonging and shared commitment to making a historic impact in these small communities was crucial to their involvement and the success of this program.

3.3 'Communication of Science for Non-Scientific Audiences' workshop

As part of the ERN, a workshop was held to enhance researchers' communication skills for non-specialised audiences. The 'Communication of Science for Non-Scientific Audiences' workshop had a participation rate of approximately 15%. All attendees provided positive feedback, rating the workshop and facilitators as either 'good' or 'very good'.

Regarding the positive aspects highlighted by participants, the workshop provided valuable knowledge and examples that significantly contributed to their personal and professional development. Additionally, some participants expressed a desire for broader access to similar workshops, recognizing their transformative impact on communication skills. Furthermore, participants found the workshop highly beneficial for enhancing their communication skills and gaining practical insights into effective science communication strategies. The feedback highlighted two improvement areas: time management and collaboration with peers. Participants expected more dedicated time to explore workshop content in-depth and emphasised the value of peer feedback. The discussion also addressed ways to overcome participation barriers. Challenges related to the scheduled day and time were identified as potential limitations for broader researcher participation. To address this concern, consider offering more flexibility in scheduling future workshops.

3.4 European Researchers' Night participants perception in Armamar

The perception of ERN Armamar participants was evaluated through a questionnaire (n=121 validated responses).

The analysis of the questionnaire responses revealed overwhelmingly positive outcomes, indicating a significant shift in participant perspectives (Figure 1).

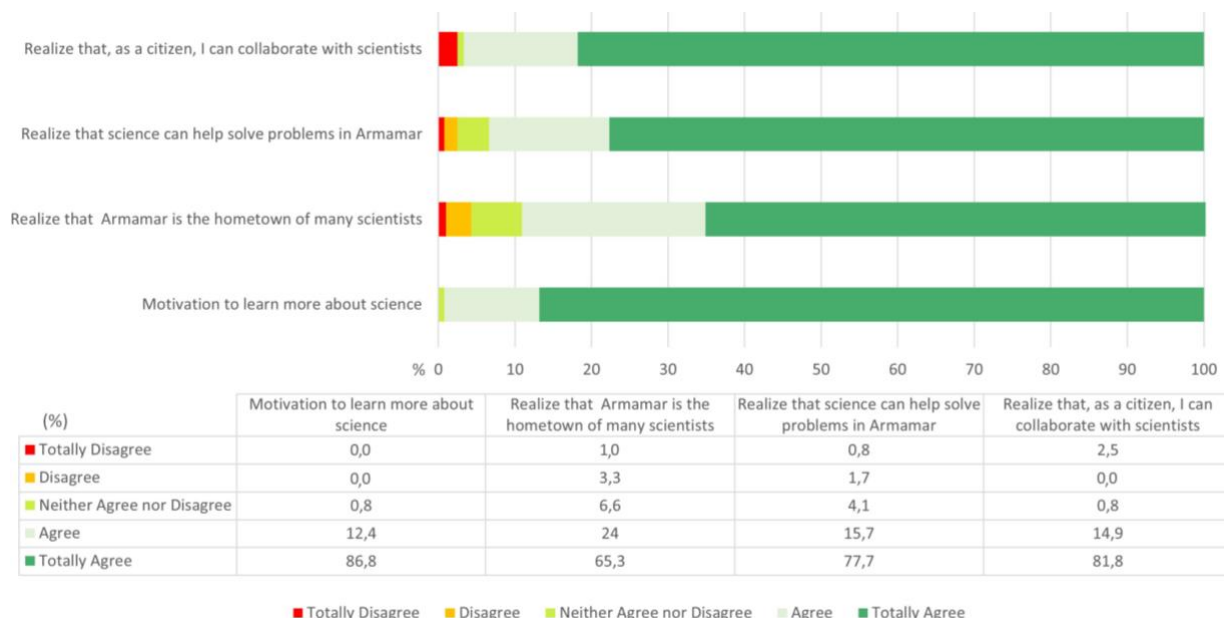


Figure 1. The impact of the Armamar European Researchers' Night initiative on its participants, including the percentage distribution of satisfaction levels for key indicators.

The event significantly increased participants' motivation to explore science, with 98% agreeing that their interest in scientific exploration was heightened. This is an indicator of a positive impact on the community's engagement with science.

The questionnaire results also revealed increased community awareness of local scientists, with 89% of participants agreeing or totally agreeing that this event allowed them to realise that their communities are a source of many scientists. The event effectively highlighted the presence and contributions of local researchers, leading to increased awareness.

Ninety-three percent of participants agreed or strongly agreed that the event improved their understanding of science's potential to address local issues. This outcome demonstrates the effectiveness of the initiatives in bridging the gap between scientific knowledge and its practical application in community problem-solving.

The questionnaire revealed a strong inclination towards community involvement in scientific endeavours promoted by their participation in ERN. 97% of respondents indicated their eagerness to collaborate with scientists as active citizens caused by this event. This reflects a positive shift towards fostering engagement between the scientific community and the public, signifying the success of initiatives in promoting active citizenship and fostering a sense of community-driven science.

The questionnaire results align with the objectives initially set for the European Researchers' Night initiatives in rural contexts. The event not only sparked interest in science but also raised community awareness of local scientists and their potential role in addressing community-specific challenges. These positive results also provided valuable insights into the effectiveness of the event's design and implementation. The participants' positive response indicates a receptive community eager to embrace science as a tool for local sustainable development. Therefore, the applied methodology seems to be a good practice for future event planning.

4 CONCLUSION & FUTURE WORK: CHALLENGES AND OPPORTUNITIES

This section outlines best practices for improving future ERN editions to achieve broader geographical coverage, increase impact and optimise overall effectiveness. Thus:

- 1 **Geographical expansion:** Explore strategies to expand the geographical coverage of initiatives in rural areas facing similar challenges. Start by identifying nearby underserved regions and devising more comprehensive approaches to reach remote communities. One approach could be to develop a communication strategy and form strategic partnerships with municipalities, NGOs, school clusters and science academies. Another interesting approach could be creating a community of local scientists from rural contexts interested in improving science literacy in their hometowns. Additionally, using technology to extend the reach of science outreach activities, such as online platforms complementing on-site events, could be beneficial. However, it is essential to adapt the content and structure to the unique characteristics of each rural community, including their culture, traditions and needs.
- 2 **Sustainability and Continuity:** To ensure the long-term sustainability of these initiatives in rural contexts, it is crucial to assess and explore partnerships with local organisations, institutions, and municipalities to foster ongoing collaboration and support. In addition, it is vital to ensure the commitment of engagement to the community. Developing plans for follow-up activities or original initiatives to maintain community interest in science, such as co-creation processes, could be beneficial. This requires actively seeking input from community members, understanding their unique needs and incorporating their perspectives into the planning and execution of events. Additionally, providing opportunities for researchers to contribute to local projects or educational initiatives may be of interest [12]. It is also crucial to ensure that benefits are accessible to all population groups.
- 3 **Empowering local leadership:** Work on strategies to empower local leaders, such as municipal authorities, educators, community organisers and native researchers, within the community and encourage ongoing dialogue. This will enable them to engage in future science initiatives and play a more active role in sustaining and expanding the impact of similar events.
- 4 **Long-Term impact:** To maximise the impact of future events, methodologies that consider tailored approaches to address the specific challenges and opportunities of each rural setting should be evaluated. Local teams should evaluate whether the positive outcomes observed immediately after the event persist over time and explore strategies to ensure a lasting influence on the community's attitude towards science and scientific careers. It is also essential to evaluate the broader socioeconomic impact. The strategy should consider exploring how ERN initiatives contribute to local economic development, empower communities and enhance educational opportunities in each rural setting. One interesting approach is to consider the ERN's effect on local businesses' stimulation, inspired (new) educational initiatives, or contribution to the development of community resources. This understanding will provide valuable insights for tailoring future initiatives to maximise positive outcomes for both the scientific community and rural areas.

In conclusion, our results highlighted ERN's positive impact in rural settings, underscoring the significance of such initiatives in fostering a scientifically literate and engaged society. Moving forward, this work provides valuable guidance for optimising future editions, ensuring community-driven science outreach efforts' continued success and growth.

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