

## HEROES OR VILLAINS? DEMYSTIFYING PARASITES THROUGH POP CULTURE AS A SCIENTIFIC COMMUNICATION TOOL

*Heróis ou Vilões? Desmistificando os parasitos através da cultura pop como ferramenta de divulgação científica*

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Recebido em: 12/10/2023

Aceito em: 26/05/2024

### Abstract

The scientific research developed at universities, which advances our understanding of the world, should be communicated to the general public in an accessible and distinct manner. This applies to many fields of study, including free riding, as it is essential not only for professional growth, but also for the betterment of society at large. Such research is enabling individuals to understand subjects that extend beyond their social context. In this sense, the Helminthology Laboratory participated in the extension event "UFRGS Open Doors" and created an activity named "Heroes or Villains: The Infinity Saga of Parasites". The aim of this activity was to familiarize the public with aspects of parasitology in natural environments. Drawing inspiration from the contemporary and popular theme of the movie "Avengers: Infinity War", we explored various aspects of biology including ecology, evolution, and the importance of parasites in the natural world. Visitors journeyed through six stations where we established connections between the Infinity Stones portrayed in the movie and various facets of parasitism. The participants' keen interest and motivation in carrying out the activities were evident as they enthusiastically engaged with the covered material. The significance of using accessible language for scientific communication was also highlighted.

**Keywords:** Communication, parasitism, science popularization, helminthology, university.

### Resumo

A pesquisa realizada nas universidades, que promove conhecimento científico, deveria ser disseminada de forma acessível e diferenciada para o público leigo. A pesquisa científica, englobando o estudo do parasitismo, é essencial não somente para a formação profissional, mas também para a sociedade como um todo, pois contribui para o bem-estar da população e a melhoria da qualidade de vida, permitindo que entendam assuntos que vão além de sua realidade social. Neste sentido, o Laboratório de Helminologia da Universidade Federal do Rio Grande do Sul (LabHelm/UFRGS) aderiu ao projeto "UFRGS Portas Abertas" com a atividade intitulada "Heróis ou vilões: a saga infinita dos parasitos". O objetivo dessa atividade foi trazer ao conhecimento do público aspectos da

parasitologia em ambientes naturais. Através de um tema atual e popular, utilizando como inspiração o filme “Vingadores: Guerra Infinita”, foram trabalhados aspectos da biologia, da ecologia, da evolução e da importância dos parasitos na natureza. Os visitantes percorreram seis estações onde foram estabelecidas relações entre os poderes apresentados no filme e diferentes aspectos do parasitismo. O interesse e a motivação dos participantes ao realizarem as atividades foram visíveis pelo entusiasmo em relação à compreensão do conteúdo abordado. Também foi destacada a importância de uma linguagem acessível para a divulgação científica.

**Palavras-chaves:** Popularização da ciência, parasitologia, helmintologia, comunicação científica.

## Introduction

In recent years, there has been a significant increase in studies related to the biodiversity of living organisms. However, parasites, despite their pivotal role, tend to receive comparatively limited attention, primarily due to their diminutive size, challenging observation, and the fact that most of them inhabit host organisms (Begon, et al. 2009). The concept of parasitism frequently becomes intertwined with notions of disease, poor hygiene, unsanitary environments, and even evokes a sense of "disgust". Unfortunately, this perspective often remains the prevailing view held by the general public, consequently perpetuating a lack of comprehension regarding the importance of these organisms and their intricate integration within the biological and ecological mechanisms inherent to natural environments (McLaughlin, 2001).

Since Windsor (1990) initially championed the cause of "equal rights for parasites", a multitude of research endeavors have been launched to underscore the ecological significance of parasites. These extensive studies have generated a wealth of scientific insights, further contributing to the development of conservation strategies tailored to parasite species (Carlson, et al. 2020). In this context, the dissemination and education efforts play a pivotal role in altering negative perceptions concerning parasites and nurturing and enhanced understanding of their significance within ecosystems (Rubio-Godoy & Pérez-Ponce de León, 2023).

Parasitism stands as the predominant ecological interaction on Earth (Windsor, 1998; Poulin & Morand, 2004; Marcogliese, 2005; Resetarits, et al. 2022), carrying substantial importance within natural ecosystems, playing a pivotal role in the evolutionary processes occurring on our planet (Dougherty, et al. 2016). When the role of parasite species in governing host populations and shaping communities is acknowledged, they emerge as significant contributors to the biodiversity of numerous ecosystems (Luque, 2008). Research on parasitism plays a fundamental role in fostering professional growth and improving the overall quality of life for the population. Its influence extends across diverse domains, encompassing public health, veterinary medicine, conservation, and the preservation of biodiversity. This confers advantages upon society, as it aids in enhancing the population's quality of life through facilitating a deeper comprehension of subjects that extend beyond their immediate social context (Souza, 2019). However, the assimilation of scientific content can be complex owing to its specialized and frequently inaccessible language, thereby constraining this knowledge predominantly to researchers (Bueno, 2010).

These scientific studies are often carried out within research laboratories, affiliated with educational institutions striving to nurture individuals equipped with critical thinking abilities and granting access to scientific knowledge. Consequently, the effective transmission of these specialized topics to the general public remains infrequent and constrained, creating a cycle wherein research caters exclusively to those actively involved in research activities, inadvertently overlooking the broader community (Bueno, 2010).

Alternatively, science communication offers a solution. It can be defined as "the use of methods and technical resources to communicate scientific and technological information to the general public" (Bueno, 1984; Macías-Chapula, 2012; Machado, 2016). Thus, science communication employs a range of resources and methodologies to translate specialized language into lay terms, aiming to reach a wider audience and ensuring accessibility to scientific knowledge (Ribeiro & Kawamura, 2014; Fraga, 2012; Machado, 2016). Science communication efforts are the focus of scholars spanning various fields of knowledge, underscoring the importance of fostering a culture rooted in scientific understanding. In other words, beyond the dissemination of scientific knowledge, this form of communication assumes a vital role in prompting society to engage in contemplation regarding science and technology (Lordêlo & Magalhães, 2012). According to Loureiro (2003), science communication stands as a preeminent specialization within information science, yielding a multitude of insights. These dialogues orbit the creation and transmission of scientific information, while also considering society's engagement within these intricate processes (Loureiro, 2003).

Silva (2014) highlights the crucial role of postgraduate education in advancing the popularization of science, shedding light on the societal purpose intrinsic to this level of education and higher education establishments. The National Postgraduate Plan (Brasil, 2010) presents a new approach that seeks to have a relationship between science and society. It posits that this relationship can only truly flourish when all citizens are endowed with scientific education and cultural proficiency, empowering them to effectively grasp and navigate their daily existence while engaging with it critically and autonomously. The National Council for Scientific and Technological Development (known as CNPq in Portuguese) hosts a website titled "Why Popularize?" which underscores the importance of extending the reach of "scientific and technological findings beyond the confines of academia, ensuring their broad distribution to society" (CNPq, 2019).

The dissemination of science dates back to the inception of scientific practice, with scientists historically exchanging their discoveries and experiments. This form of scientific communication played a crucial role in propelling scientific advancement, targeting an audience already familiar with the subject matter, possessing the ability to grasp new terminology, processes, and concepts within their respective domain (Bueno, 2010). However, despite the pivotal role of science communication in propelling scientific progress is acknowledged, challenges persist in the realm of science popularization. These challenges encompass constraints stemming from limited financial resources to the qualification of teams involved in such endeavors. Such issues contribute to the critique that science is, frequently, perceived solely as a body of knowledge confined to research laboratories (Piccoli & Stecanela, 2023).

Science communication texts for ought to adopt a distinct language compared to scientific discourse, marked by reduced formality and a more relatable alignment with everyday language. These texts should have crafted with specific objectives, aiming to reach a diverse and broad audience through a variety of dissemination channels (Nascimento & Rezende, 2010).

Thus, there is a strong emphasis on leveraging films as a powerful tool for advancing science communication, fostering contextualization within a fictional narrative, thereby facilitating a deeper understanding of the subject matter among the intended audience (Silva & Calafate, 2021). According to Vicentino and Sant'Ana (2010), films have long served as a vehicle to heighten interest, foster critical thinking, expand horizons, and kindle the pursuit of knowledge. Furthermore, films can ignite enthusiasm for science within audiences, potentially nurturing a degree of scientific literacy and even inspiring individuals to embark on scientific careers (Suppia, 2006).

To bridge the gap in accessible knowledge dissemination to the general public and foster the popularization of science, the University inaugurated an annual outreach event named "UFRGS Open Doors" (UFRGS Portas Abertas in Portuguese) in 2003. This event offers the community an

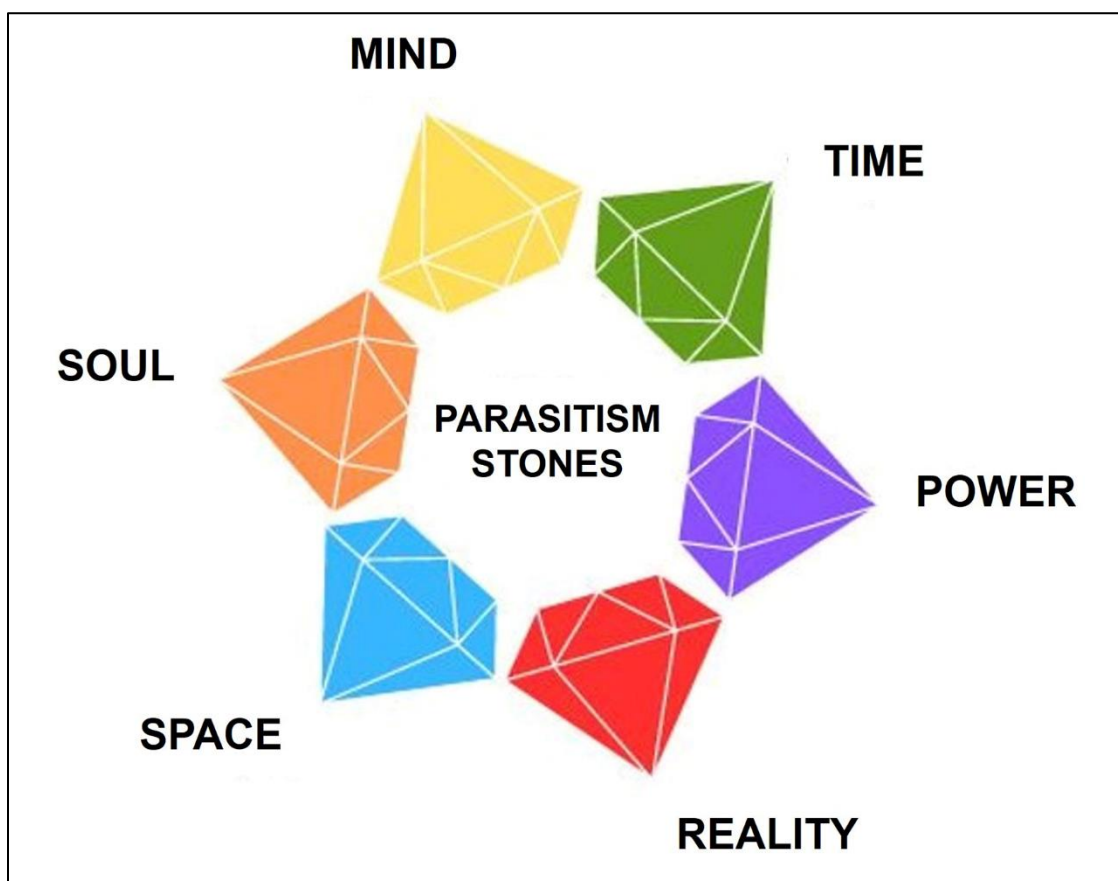
opportunity to acquaint themselves with the university and gain insights into the various pursuits encompassing education, research, and outreach (UFRGS, 2023). Furthermore, it nurtures enhanced integration between the university and the broader community, affording individuals the chance to interact with research settings and thus forging a link between the lay public and the academia. As part of this event's initiatives and with the aim of disseminating knowledge and demystifying aspects of parasitology in natural environments, the Helminthology Laboratory created an engaging activity named "Heroes or Villains: The Infinity Saga of Parasites".

## Methods

This study employed the qualitative methodology, a methodology previously explored by authors like Flick (2008), Coutinho (2013), Estrela (2018), and Pereira, et al. (2018). According to Mól (2017), the qualitative approach characterizes "science as an area of knowledge shaped by social interactions within the encompassing socio-cultural context. Therefore, the focus lies in comprehending the significance of phenomena from the viewpoint of those immersed in them".

The science communication activity was named "Heroes or Villains: The Infinity Saga of Parasites," drawing a captivating parallel to the Marvel Studios' movie "Avengers: Infinity War", which served as a wellspring of inspiration for its conception. The selection of this film was due to its worldwide fanbase's immense anticipation and its remarkable historical achievements in box office records, spanning both initial weekend receipts and total earnings (Santos, 2020). The activity was carried by the Helminthology Laboratory during the "UFRGS Open Doors" event.

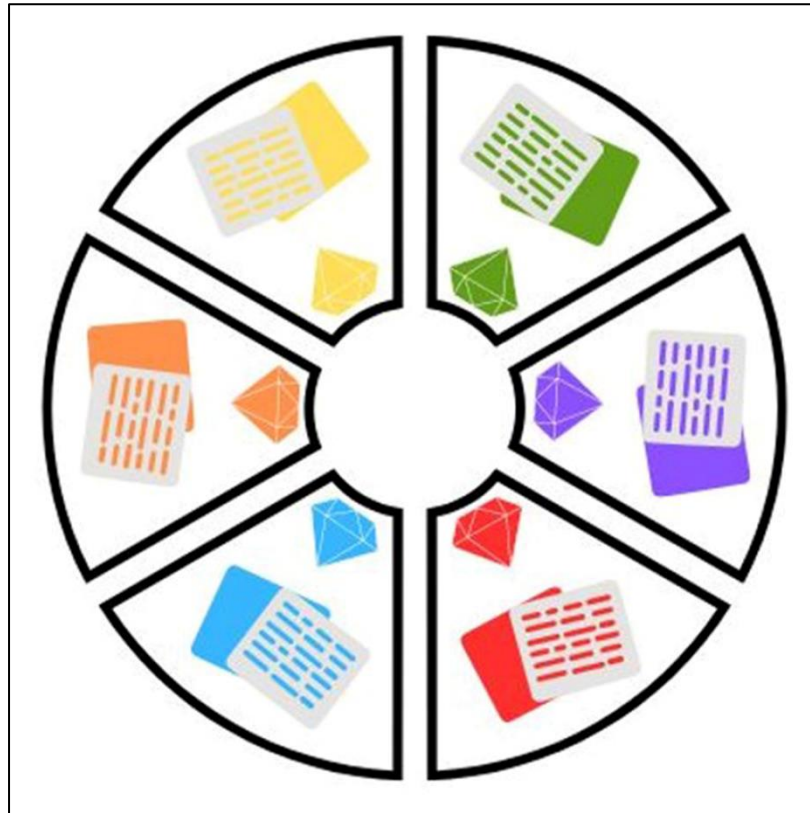
Various facets of biology, ecology, evolution, and the pivotal role of parasites in the natural environments were explored, weaving connections between these subjects and the Infinity Stones portrayed in the movie. As a result, we have created six "parasitic stones" (Figure 1), each focusing on particular elements: the Reality Stone, depicting the concept of parasitism; the Space Stone, highlighting the locales of these interactions; the Soul Stone, delving into the life cycle of parasitic helminths; the Mind Stone, unraveling the intricate manipulation of hosts; the Time Stone, tracing the evolutionary path of parasites; and the Power Stone, underscoring the importance of parasites within ecosystems.



**Figure 1:** Parasitism stones.

To captivate the curiosity of visitors and ignite their interest, custom-designed arrows adorned with thematic elements were made and strategically placed throughout the university premises, directing and beckoning attendees toward LabHelm/UFRGS. Each of these arrows was adorned with phrases intricately tied to the theme, skillfully doubling as engaging clues aimed at enticing and immersing the visitors.

Upon reaching the laboratory, visitors were greeted by the sight of a prominently displayed poster bearing the activity's title. A cordial reception awaited them from two guides, who would then accompany the visitors to a designated table (Figure 2). Here, an engaging narrative awaited unfolding as follows: "The Infinity Stones symbolize distinct facets of the universe: Red – reality; Blue – space; Orange – soul; Yellow – mind; Green – time; Purple – power. When these stones are gathered in a gauntlet, they confer absolute power over the universe. The superheroes gathered to combat the supervillain who managed to assemble these Infinity Stones. So far, we've been discussing through a realm of fiction, however, we can broaden our horizons and extend this narrative to our scientific domain: PARASITISM. In the natural world, intricate networks of interactions interlace among living beings. To sustain the flourishing of animals, plants, and other organisms within an ecosystem, a balance among these interactions is paramount. Surprisingly, parasites, despite their vilified status, assume a significant role in this narrative. They possess various "powers" or strategies, analogously portrayed here by the Infinity Stones. Each strategy wields a profound influence on the lives of both parasites and their hosts (the organisms that harbor them). Yet it is only when these strategies unite that they embody the "absolute power", preserving the survival of parasites and fostering balance of ecosystems. Much like the movie, the parasitism gauntlet only wields its potential when all stones align. Hence, delve into the potency of each parasitism stone".



**Figure 2:** Table layout with introductory storyline integrating pop culture and parasitism knowledge.

During this initial stage, visitors adeptly contextualized the theme of parasitism through the lens of the Avengers movie. Following this immersive introduction, they were guided to the other stations, where comprehensive explanations on specific subjects awaited. These subjects were symbolically embodied by the parasitism stones, with each station thoughtfully designed to encompass an array of visual resources. These included optical microscopes, complete with slides for meticulous observation of specimens, as well as illustrative diagrams and captivating images employed to convey intricate information. Additionally, a dedicated monitor was stationed at each station, adeptly expounding the content. To ensure a coherent and seamlessly progressive experience, all activities were meticulously arranged in a logical sequence for the visitors' benefit.

The visitors journey commenced at the first station, representing the "Reality Stone," where a monitor introduced the topic of parasitology. Clear explanations concerning parasites were offered, thought-provoking questions were posed to gauge the visitors' grasp, and specific attributes of these organisms were thoroughly explored. Supporting materials comprised an informative poster and an optical microscope, facilitating the meticulous observation of distinct parasite specimens. Transitioning to the second station, designed as the "Space Stone," a detailed exploration unfolded into the habitat of parasitic helminths, concurrently elucidating the concepts of definitive host and intermediate host. These explanations were effectively communicated using images and diagrams, enhancing language accessibility. Advancing to the third station, designed as the "Soul Stone," attention centered on the intricate life cycle of these organisms, encompassing the various stages required for their maturation into adulthood. The demonstration effectively showcased that the absence or disruption of any phase within this cycle could directly affect the parasite. To elucidate these concepts, an illustrative representation of a parasite species' life cycle was employed. Within this depiction, the "characters" involved were strategically situated across distinct tissue locations, facilitating a narrative presentation that could be interpreted from diverse perspectives. Visitors had the opportunity to actively interact with this material and formulate their individual insights regarding

life cycles. Transitioning to the fourth station, designed as the "Mind Stone," a captivating display unfolded, spotlighting diverse strategies employed by specific parasite species to ingeniously manipulate their hosts and amplify transmission. Elucidations were provided regarding the mechanisms underlying these manipulations, bolstered by the inclusion of an illustrative video showcasing how a specific parasite species can manipulate its host. Progressing to the fifth station, designed as the "Time Stone," the monitor elucidated the parasite origins, their evolutionary journey, and the remarkable adaptations that have propelled them to thrive within contemporary environments. At this station, the utilization of an optical microscope came into play unveiling slides featuring an array of parasite species for the meticulous examination of their structures. Lastly, at the sixth station, designed as the "Power Stone," a synthesis was presented, interweaving the insights from the preceding stations. Here, the intricate relationship between parasites and food webs was unveiled, spotlighting their crucial roles within natural ecosystems. To bring the experience to a poignant close, the collection of parasitism jewels was underscored with a final message: "Equal rights for parasites", a compelling phrase coined by Windsor (1990), an eminent advocate for acknowledging parasites as integral and significant components of natural ecosystems.

### Results and discussion

During the activity organized by LabHelm/UFRGS, a diverse spectrum of participants engaged, encompassing individuals spanning different ages and educational levels. A substantial portion of the visitors possessed familiarity with human parasites, leading to an inherent correlation of helminths with diseases. Visitors exhibited a keen curiosity regarding parasitic helminths in wild animals, leading to a multitude of inquiries and lively discussions during the concluding segment of the visit. Consequently, a number of attendees were surprised by the sheer diversity and pivotal roles these organisms play within ecosystems. This underscores the significance of such activities in disseminating scientific knowledge and cultivating an optimistic viewpoint concerning parasitic helminths.

At the beginning of the activity, participants made various comments such as, "Oh, I don't know if I want to see it, worms are disgusting", and others asked us, "Are they alive?". Many comments revolved around the diseases these animals could cause: "I remember a disease I learned about in school that was caused by this worm", or "Oh, I remember the teacher showed a video about this parasite that caused stomach pain and swelling." Initially, visitors only saw the negative aspects of the diseases caused by these parasites. However, as they progressed through the activity, they realized that parasitism is a complex system that goes beyond diseases. Their perception shifted, and their questions turned into curiosities about these animals' lifestyles: "But how do they manage to live inside another animal without harming it?", "Oh, so they need other animals to become adults?", "Wow! I didn't know that!". At the end of the circuit, they were eager to learn more about these organisms with a new perspective. Many told us they were unaware of the importance of these animals to nature and that they learned a lot from the activity. This experience was so powerful for some students that when they became undergraduates in Biological Sciences, they reported that they had been to the activity "Heroes or Villains: the Infinite Saga of Parasites" and that it had helped them decide to become biologists. Scientific communication plays a pivotal role in disseminating science knowledge, functioning as a bridge connecting scientists with the general public. It ensures that the wealth of knowledge cultivated within universities and research centers becomes accessible to every citizen, empowering them to make well-informed decisions in their day-to-day lives (Caldeira & Santos, 2022). Furthermore, scientific communication not only enriches the realm of scientific discourse but also serves as a catalyst for nurturing fresh talent and encouraging their participation in scientific endeavors (Dias, et al. 2017). Consequently, we underscore the significance of conducting scientific outreach initiatives like the UFRGS Open Doors, which serves as a source of inspiration, bridging the gap and forging a strong connection between the population and the academic sphere.

Numerous authors have documented their forays into science communication within the context of scientific events. Pires (2016), for example, examined science communication events such as the Open Day at the Institute of Chemical and Biological Technology António Xavier and the Scientist Visit Our School program. The findings of the examinations led to the conclusion that these initiatives yield mutual benefits for both the attendees and the researchers involved. These initiatives facilitate direct engagement with science in a relaxed and informal ambiance, effectively dismantling barriers that often separate the two spheres. Romani, et al. (2018) detail their experience in implementing science communication strategies, encompassing educational museum visits, organizing science communication events, and the dissemination of event information via social networks. The authors conclude that the establishment of novel venues and technologies is imperative for fostering a more intimate connection between science and the community. This includes the creation of fresh-themed museums or accessible laboratories. Moreover, they underscore the essentiality of bolstering the communication aptitude of researchers and scientists to ensure effective science communication. Deccache-Maia, et al. (2010) conducted work aimed at bridging the gap between laboratories and the general public. Their efforts materialized in the form of a mobile scientific education program, meticulously designed to disseminate knowledge encompassing health, disease prevention, and broader scientific subjects. According to the authors, their aim revolves around augmenting scientific literacy and, in turn, facilitating the acquisition of scientific knowledge. Another example involves the establishment of an interactive science and technology laboratory, dedicated to both training and the dissemination of scientific information. This endeavor capitalizes on dynamic and interactive modes of learning, with academic concepts being presented in approachable manner, enhancing comprehension (Oliveira & Oliveira, 2020).

It is essential to underscore that scientific outreach carries the potential to ignite scientific vocations and foster a genuine affinity for science. Moreover, in scenarios where these elements are already present, outreach endeavors can serve as a catalyst for augmenting public involvement within the field, whether pursued as a recreational interest or a full-fledged profession. As a result, this accentuates the societal responsibility of researchers, who, through active participation in science communication, play a pivotal role in nurturing a populace equipped with a strong and well-rounded scientific education. Furthermore, such initiatives frequently have the potential to augment formal education, as the insights gained from such experiences can seamlessly integrate into the school environment (Massarani & Moreira, 2016).

The language employed in scientific outreach must exhibit clarity and conciseness, effectively distilling complex content to cater to diverse audiences of varying ages, encompassing both laypersons and experts. Consequently, utilizing a superhero film as a conduit to elucidate parasitology in a more accessible manner stands as an exceptional tool for effectively communicating with the general public. An integrated scientific education, centered on scientific methods, harmonizes seamlessly with the development of "citizen science," thereby fostering the formation of shared knowledge intertwined with sociocultural dimensions. Encouraging the public to embrace the role of a researcher, thereby delving into the intricacies of scientific processes, represents a pathway toward nurturing "citizen science." This approach not only champions active engagement but also cultivates a profound grasp of scientific tenets.

## Conclusions

We acknowledge that the role of a science communicator is far from simplistic, demanding both unwavering determination and patience to translate scientific jargon into everyday language. However, the satisfaction derived from disseminating top-tier knowledge concerning a frequently marginalized group of organisms within the realm of biodiversity is truly rewarding. Employing elements of pop culture has granted us the opportunity to effectively showcase to the general public that parasites play a multitude of crucial roles within natural environments. This approach dispels the



misconception that parasites are solely synonymous with diseases and reshapes their portrayal from "villains" to the rightful "heroes" of numerous narratives.

In conclusion, scientific communication stands as an avenue for unveiling revelations and cultivating a deeper comprehension of the world around us. The formidable endeavor of transcending the confines of academia not only amplifies the effectiveness of discoveries but also ensures their dissemination to a wider and more diverse audience. Scientific research holds pivotal significance not solely for individual professional growth, but for the collective welfare of a society at large. Its contributions extend to enriching the quality of life for the populace, empowering them to grasp subjects that transcend their immediate social reality (Souza, 2019). In this context, scientific communication endeavors encompass a broader ambition. While they certainly play a role in nurturing future scientists, their foremost purpose lies in the accurate dissemination and discourse of scientific subjects. By ensuring that these subjects are comprehended and deliberated upon, the ultimate aim is to enhance our collective comprehension of the world and its intricate mechanisms.

In light of this reality, it becomes imperative for scientific outreach initiatives to garner greater visibility within educational institutions and public domains. These endeavors serve to convey the intricate web of social, cultural, and historical elements that underpin scientific endeavors. By demystifying both the realm of science and scientists themselves, such practices play a role in nurturing a resilient scientific culture. In the context of parasitic helminths, effective dissemination and education assume paramount importance. They act as catalysts in instilling an appreciation for the roles of these organisms in the intricate functioning and structure of ecosystems. Additionally, they strive to reshape negative perceptions, transcending the simplistic notion of them as mere villains.

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