GROWING GREEN HEARTS:

Inspiring the Next Generation with Planetary Health Education

PLANETARY HEALTH ALLIANCE

CONTENTS

We live in a complex time full of breathtaking information and advanced technologies. We are increasingly feeling challenges imposed by climate change, losing biodiversity, and the overcoming of our planet's support limits. In this context of complexity that the Anthropocene brings us, we have to educate young people by providing good examples and fostering hope, not just for the future, but for present times as well.

We believe that the Planetary Health (PH) movement can be an inspiring path that gives us clues to overcoming the myth of human exceptionalism and recognizing ourselves as an intrinsic part of nature. Developing educational materials, policies, and actions on PH for various audiences is a necessary task on the road to activating the Great Ecological Transition that will herald the values and achievements dear to humanity while protecting all forms of life and the systems that allow them to live.

This book was born out of a desire to contribute to thinking about strategies and ways of educating children about planetary health. It should not be read as a prescription to be followed to the letter, but a collection of stories and ideas centering on planetary health in various educational contexts to spur ideas in your own community. It was created with the mission of being an inspiration for initiation and highlighting crucial considerations to be made in an educational plan of action in PH for children and young people by sharing relevant experiences from authors who have different connections to the movement.

Inspired by Paulo Freire's Latin American tradition of popular education and the systematization of experiences, this material was built collectively. Each chapter is written by authors who had previous connections to the Planetary Health Alliance. Each was asked to contribute to a chapter detailing the story and context of the creation and development of different PH educational activities and curricula, each adding their own faces, colors, and accents to this process.

By bringing together Latin American experiences, this material seeks to help us think about planetary health from a decolonial lens. This shift

allows for the valorization of social mobilization, care, and regeneration of natural systems from a perspective of the global south, which often dialogues with ancestral ecological knowledge recorded for millennia, as with indigenous populations, quilombola communities, riverside communities, caiçaras, and other traditional peoples of the region. The book begins with a glimpse of how planetary health appears in research on education geared towards young people, an essential record for us to understand how this theme has grown and encourages us to think about strategies to further promote it.

The following chapters bring together experiences from various backgrounds and settings, which include activities in classrooms, educational gardens, teacher training experiences in the Amazon, and activities mobilized by young climate activists. We invite readers to share these experiences and find enthusiasm in the mobilizing energy of these stories.

Each of us has a role to play in planetary health, and education is a key driver. In what ways can you activate educational actions for children and young people in your communities? May these examples serve as inspiration so that we have new experiences to share!

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LITERATURE REVIEW

Planetary Health in Basic Education:

Insights from Global Literature on the Subject

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Introduction

Humanity and ecosystems have been interconnected since the dawn of civilization. With the contemporary confluence of accelerated population growth, unsustainable consumption patterns, and the intense presence of technology in everyday life driving changes in natural systems, it is increasingly necessary to think, act, and alter our actions in order to secure a sustainable future, minimize the negative effects on planet Earth, and enable the survival of future generations.

In 2000, the final version of the Earth Charter launched. The principles in this document aim to guide the world towards a sustainable society that respects ecosystems, culture, human rights, justice, democracy, peace, and non-violence.

In March 2014, Horton *et al.* presented planetary health as a new field of transformative action for public welfare. Their work aimed to create a social movement built on considering the planet's health, where impactful issues such as threats to the well-being of humanity and natural systems were starting points. This initial publication asserted the necessity for a planet that nourishes and sustains the diversity of life we live and depend on (Horton *et al.*, 2014).

Planetary health is an area of study focused on understanding the interrelationships between different lifeforms and the environment and identifying solutions for the various issues affecting ecosystems that compromise the future of humanity and the planet. A 2015 publication in *The Lancet* officially defined the concept of planetary health as the fitness and interdependence of populations and natural ecosystems (Whitmee *et al.*, 2015).

According to Steffen *et al.* (2015), there is a sustainable planetary boundary in which anthropogenic disturbances destabilize natural systems and affect the health of the various species within. This definition allows us to better conceptualize how human actions play into environmental imbalances that compromise the dynamics of life on earth. According to Floss & Barros, natural systems are fundamental to human

health, however, losses and changes in these systems bring significant damage to the health of populations. Examples of anthropogenic disturbances include extreme weather events, increasing temperatures, deforestation, a decrease in biodiversity, rising sea levels, ocean acidification, desertification, altered biogeochemical cycles, and increased wear on natural ecosystems.

It is essential to consider the deep connection between socioeconomic issues and environmental issues. The consequences of anthropogenically derived natural disasters disproportionately affect vulnerable populations, as do health epidemics that require medical intervention, often barred by lack of resources or transportation. Planetary Health regards humans in a broader context that incorporates health, well-being, and equity under its umbrella of topics (Horton *et al*., 2014; Whitmee *et al*., 2015). This assertion in mind, developing actions minimizing the catastrophic effects humanity has inflicted on the environment with a focus on essential changes in the ways we live and connect to environmental systems is essential to ensuring a sustainable, healthy future for the planet and all other forms of life.

As a comprehensive, transdisciplinary theme, inserting planetary health at multiple levels of education would further promote its ideals of global and societal preservation. To increase responsibility for environmental sustainability in future generations, striving for greater social equity, and living in symbiosis with their natural surroundings, inserting the study of planetary health into core education is essential.

This literature review was developed in the Post-Graduation Program in Science Education: Chemistry of Life and Health at the Federal University of Rio Grande do Sul (PPgECi/UFRGS). The goal was the review of scientific publications and proposals dedicated to incorporating planetary health as a core science topic for elementary, middle, and high school students. This survey of publications centered on work produced since the inception of the term “planetary health” in 2015 continuing to 2021.

Activity Description

The data upon which this writing is based were sourced through various means, which included use of Google Scholar, Scielo, Web of Science database, and in the abstracts and research provided by the Planetary Health Alliance following their Planetary Health Annual Meeting (PHAM).

Our initial focus found us seeking research with primary and secondary students as their principal subjects. We used the search terms, "children AND planetary health" and "planetary health AND teaching science." After the search, it was possible to systematize the bibliographic data in Microsoft Excel, as shown below (Table 1).

Table 1. Studies on planetary health in education with children and young people.

AUTHOR(S)	WORK TYPE	TITLE	SOURCE/YEAR OF PUBLICATION
Stone, S. B.; Myers, S. S.; Golden, C. D.	Paper	Cross-cutting principles for planetary health education	The Lancet Planet Health, 2018
Solomonian, L.	Paper	Promoting Planetary Health: A Necessary Part of Caring for Children	Naturopathic Doctor News & Review, 2021.
Guzmán, C. A. F.; Aguirre. A.; Astle, B. *et al.*	Paper	A framework to guide planetary health education	The Lancet Planet Health, 2021.
Taillie, L. S.; Bercholz, M.; Popkin, B. *et al.*	Paper	Changes in food purchases after the Chilean policies on food labeling, marketing, and sales in schools: a before and after study	The Lancet Planet Health, 2021.
Von Borries, V.; Guinto, R.; Thomson, D. J.; A Abia, W. *et al.*	Paper	Planting sustainable seeds in young minds: the need to teach planetary health to children	The Lancet Planet Health, 2020.
Rutter, O.	Editorial	Power to the children	The Lancet Planetary Health, 2019
Myers, S.; Pivor, J. I.; Saraiva, A. M.	Paper	The São Paulo Declaration on Planetary Health	The Lancet Planetary Health, 2021.

Table 1 (cont)

AUTHOR(S)	WORK TYPE	TITLE	SOURCE/YEAR OF PUBLICATION
Vanwormer, E.; Mlawa, J.; Komba, E. *et al.*	Abstract	Using art and story to explore how primary school students in rural Tanzania understand planetary health: a qualitative analysis	The Lancet Planetary Health, 2018
Sedhain, S.	Abstract	ECO-ED: Driving Change in the Climate Movement by Empowering Youth Leaders	Reunião Anual de Saúde Planetária (PHAM), 2021
Gnanapragasam, J.	Abstract	Empowering food literacy and building community one dish at a time	Reunião Anual de Saúde Planetária (PHAM), 2021
Vanderlee, L.; Martins, C.; Ramsing, B. *et al.*.	Abstract	"Food Choices for a Healthy Planet", an online educational tool to support improved understanding of the complexity and impacts of food choices	Reunião Anual de Saúde Planetária (PHAM), 2021.
Colnago, N.A. S.; Radicchi, G. R.; Lee, D. A. *et al.*	Abstract	An Interdisciplinary Study With Eighth Grade School Children: Teaching Nutrition For Healthy Eating	Reunião Anual de Saúde Planetária (PHAM), 2021.
Berchez, F.A.S.; Arruda. L. G. L.; Souza, G. H.; *et al.*	Abstract	Teachers' perspectives on environmental issues and the development of educational activities in Conservation Units	Reunião Anual de Saúde Planetária (PHAM), 2021.
LeClair, J.	Abstract	Building Kincentric Awareness in Planetary Health Education: A Rapid Evidence Review	Reunião Anual de Saúde Planetária (PHAM), 2021.
Bodmer, S.	Abstract	The role of serious games and youth as co-designers in future healthy and sustainable city world-building	Reunião Anual de Saúde Planetária (PHAM), 2021.

Table 1 (cont)

AUTHOR(S)	WORK TYPE	TITLE	SOURCE/YEAR OF PUBLICATION
Otieno, M; Jung, L; Moonga, G.	Abstract	Learning for the planets future: transformational planetary health education in the Eastern African Region	Reunião Anual de Saúde Planetária (PHAM), 2021.
Zanzi, A.; Ante-Testard, P. A.; Gonzales, M. C. *et al.*	Abstract	Planet: building a Young professional community to spread planetary health awareness	Reunião Anual de Saúde Planetária (PHAM), 2021.
Berchez, F. A. S.; Arruda. L. G. L.; Souza, G. H. *et al.*	Abstract	Conservation Units to promote Education and Well-being of students from public schools in São Paulo State, Brazil.	Reunião Anual de Saúde Planetária (PHAM), 2021.
Arruda, L. G.; Berchez, F. A. S.	Abstract	Protected areas and it's guardians: gathering data from public schools for enhancing outdoor Environmental Education policy-making	Reunião Anual de Saúde Planetária (PHAM), 2021.
Wu Melody; Karle-Bhat, S. J.; Guzman, V. *et al.*	Abstract	ABCs of Planetary Health: A children's book initiative	Reunião Anual de Saúde Planetária (PHAM), 2021.

Next, we conducted a thematic analysis of these publications to present data and perspectives that guided a discussion of the need for planetary health themes in educational institutions. To facilitate organization of the documents, we focused on the general characteristics of the works, questions related to research, and recommendations made within this burgeoning field of study.

Results

Considering our Anthropocene perspective, education is a powerful weapon for changing human behavior, especially concerning interrelationships with environmental systems. The human species impacts the natural systems in which it lives and consequently suffers from the

responses of them, further emphasizing the necessity of transdisciplinary solutions that address both environmental problems and resulting health repercussions.

During the literature review, scarce articles pointed to the need to tie planetary health to primary education. In response, the source search expanded to include works on official websites in planetary health, specifically, from the PHAM between 2018 to 2021. Relevant works were also found in The Lancet Planetary Health from 2018. However, in the years following, there were not any publications regarding planetary health and primary education available.

After presenting the delimitations, twenty records remained in the shown databases, including articles, editorial material, and complete abstracts of the PHAM.

Discussion

Throughout the research and review, most of the publications found in the aforementioned database addressed planetary health through the lens of training health professionals, demonstrating the incipience of planetary health in primary education. Additional research aimed at developing educational materials and strategies for all ages is crucial to the global implementation of positive change affecting planetary health

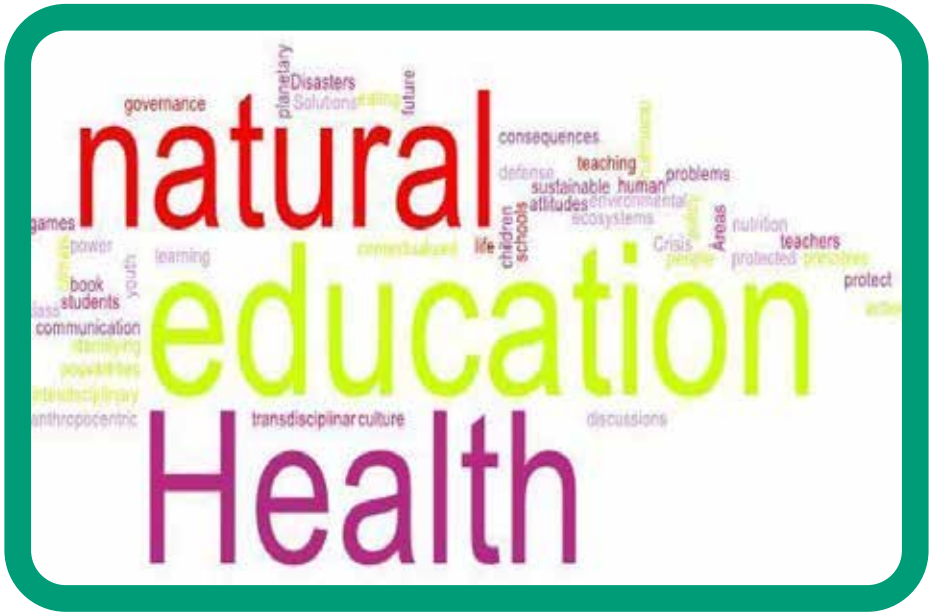
During the thematic analysis, it was essential to think about the concept of planetary health presented in each publication. In this sense, we observe the environmental theme mainly as it relates to climate change. There is a need to expand the connections of planetary health with input from diverse perspectives. The transdisciplinary themes of planetary health would hugely benefit from multiple backgrounds and knowledge bases working towards solutions.

Using a word cloud tool, they analyzed the publications and scientific papers making up our research base, the foremost keywords of which are presented in Figure 1.

Central and primary to these articles was the term “education.”

Persistently reiterated throughout these publications was the necessity for basic education as effective anthropogenic prevention. This pedagogical gap leads us to consider the role of education in the planet's future and that of humanity.

Figure 1. Most cited words in the analyzed works.



We need urgent global community actions to address anthropogenic impact. Education is one avenue by which we could achieve changes towards sustainable development. Contextualizing humans as part of the environment is essential to this process. Understanding the human effect upon the environment, to include habits, attitudes, and values, and the consequences of these factors could lead to a decrease in environmental harm as, ultimately, this confluence determines future outcomes.

It is worth mentioning that environmental issues presented in the documents guiding education at a global level, in specific disciplines, and in transversal themes at all levels, view the urgency of measures to solve the existing crises. Thus, schools are potentiating spaces to address the themes of planetary health, which makes the meaningful participation of governments and professionals in committing to enacting policy and training aimed at sustainability critical. The 2030 Agenda for Sustainable Development shows the need for students to gain knowledge and skills

that promote sustainable development through sustainable lifestyles, human rights, gender equality, promoting a peaceful culture of non-violence, global citizenship, and the appreciation of cultural diversity's contribution to sustainable development (Agenda 2030, 2018, p. 20).

In this sense, it is important to consider planetary health from a decolonized scientific perspective. Doing so allows for interpreting dialogues originating from a multiplicity of knowledge that focus on sustainability and the understanding of human beings as part of nature, increasing the possibility of assembling strategies that minimize and resolve discussed environmental issues (Guzman *et al.*, 2021).

A regional focus on natural sciences effectively contributes to quality science education. A dependence on natural environments as teaching tools connects students to directly applicable contexts. This enables integral gains in the overall health and wellbeing of humanity while simultaneously instilling an appreciation of knowledge from various cultures, such as ancestral plant knowledge or more contemporary studies about animals.

Following the review of supporting research, we opted to divide these scientific papers to align with our thematic analysis of two existing categories: research that emphasized the need to broach the topics of planetary health with youth as a proactive countermeasure and research that specifically centered on planetary health within the context of schools and pedagogy.

Both considered, a great need exists for institutions to outline solutions to intensifying natural disasters. Planetary health specifically calls to include young people in finding these fixes because these are voices equally capable of identifying solutions and adaptations that speak to the planet's problems. Their investment becomes their reward as they age and see the outcomes of their environmental interventions, whether positive or negative.

With the future planet awaiting children as the focus, an editorial published in 2019's Lancet Planetary Health presents reflections on the

failures of adults to act in preserving Earth, additionally warning that the voices of children and young people are important in the fight of restoring the damage by anthropogenic environmental catastrophes. The editorial concludes with a focus on the need to redefine civil society to guarantee the future of planet Earth, further asserting that climate change and planetary destruction are consequences of inadequate use of natural systems.

Another unfortunate byproduct of the climate crisis is the anxiety young people feel about it, noting some level of distress about the future of the planet. In 2021, The Guardian interviewed youth from countries that included Australia, Brazil, Finland, France, India, Nigeria, Philippines, Portugal, the United Kingdom and the United States. Four out of ten of their pool reported that their fears about planetary health affected their desire to have children. Three-quarters of the interviewees agreed with the statement, “The future is scary.” When considering the impact of poor planetary health on the physical and mental well-being of humans, it seems prudent to enact changes based on input from multiple resources while there is still time for positive outcomes.

The inhibition of youth to reach their potential because of technology-focused mores guiding policy rather than those that work in harmony with nature is an important consideration when reflecting on contemporary geopolitical stances and the ecological outcomes to which they lead, particularly when thinking about the scale and ways in which technology drives societal expansion. Encouraging children to take personal responsibility for their impact on nature and show compassion is a way to empower them to ascend into future environmental leadership that reflects the genuine needs of the planet. (Von Borries, Guinto, Thomson, 2021; Solomonian 2021).

In the United Nations 2030 Agenda for Sustainable Development, one repeated area of potential impact was educational institutions and curriculum. The role of these in disseminating themes of global interest; empowering knowledgeable dialogue; altering attitudes about nature

and preservation; and instilling a commitment to habits that promote environmental sustainability was highlighted as a key strategy to ensure growth that respects the well-being of local inhabitants.

Scientific publications regularly point to the necessity of incorporating planetary health into school curricula. Part of meeting the goal of sustainable development is the inclusion of planetary health throughout subjects and educational levels, fostering the development of strategies to restore the health of the planet while still allotting for growth (Guzmán *et al*. 2020).

A multidisciplinary, participatory approach would hugely affect the efficacy of a favorable planetary health transformation, a stance made clear in the São Paulo Declaration on Planetary Health, published in 2021. This document affirms the need for "A Great Transition", which included prescriptions to various industries as to specific planetary health targets to meet, emphasized the necessity to care for the health of all, and called for the creation of policies that prove a focus on fostering youth leadership, priming them to take the helm of leadership regarding environmental issues in the future.

To support this movement towards global connection, the Planetary Health Alliance proposed a set of transversal planetary principles for all levels of education as a basic tool for guidance in teaching planetary health (Stone *et al*., 2018). These principles use regional characteristics, cultural heterogeneity, and various ecologically minded academic disciplines to articulate planetary health in different contexts, rightfully affording a space for regional Indigenous knowledge in the discussions of locally minded solutions.

A thorough analysis found these reviewed documents further fit into the following themes: Planetary Health in Education, Climate Change in Education, Food, & Pedagogical Introductions of Planetary Health in Education

Planetary Health in Education

Abstracts of research and opinions presented at PHAM review how the concept of planetary health has been incorporated into classroom learning. Some relevant titles include:

- Using Art and Story to Explore How Primary School Students in Rural Tanzania Understand Planetary Health: a Qualitative Analysis
- Planet: Building a Young Professional Community to Spread Planetary Health Awareness
- Learning for the Planet's Future: Transformational Planetary Health Education in the Eastern African Region
- Conservation Units to Promote Education and Well-being of Students from Public Schools in São Paulo State, Brazil
- Teachers' Perspectives on Environmental Issues and the Development of Educational Activities in Conservation Units
- Building Kincentric Awareness in Planetary Health Education: A Rapid Evidence Review
- Protected Areas and their Guardians: Gathering Data from Public Schools for Enhancing Outdoor Environmental Education Policy-making

A mutual assertion that it is necessary to include planetary health at all levels of education as a key strategy to promote sustainable development of the local and global environments primarily united the studies above. While the concept is foundational, action being an integral piece of the learning experience, awareness and altering attitudes are equally important to the goals of increasing positive anthropogenic actions and spreading the tenets of planetary health.

The methodologies applied to the articles centered on lectures, interactive workshops, webinars, workshops, a Photographic Advocacy for Nature contest, blogs, questionnaires, scientific illustrations and literature reviews. The target audience of the works were teachers, students, health professionals, specialists in the environment, agriculture, religious lead-

ers and academics. As an interdisciplinary area, the proposals established positive results and partnerships to establish sustainable awareness on planetary health as a theme.

Works centered on the human-environment connection allowed us to gain a better perspective of the research currently available that takes an anthropocentric approach, besides the appreciation and availability of other types of traditional indigenous knowledge.

Education in natural environments enables contextualized learning and drives connections between students and their local environment. Professionals who incorporate local natural resources into their teachings with a mindset of interconnection empower student gains in cognition and well-being. Field activities engage learners to take meaningful, behavior-altering steps regarding climate change as some of its effects are contextualized in real time. To meet the goal of expanding environmental education, educator professional development should include the principles of planetary health, continually updating as the field adapts to newfound knowledge.

Climate Change Education

A common thread through the climate change education theme was an emphasis on using education to inspire young people to be knowledgeable participants in climate movements. One work worth highlighting is entitled, “ECO-ED: Driving Change in the Climate Movement by Empowering Youth Leaders”. Stated was the importance of ensuring that youth leaders have the skills to develop effective policy. This is essential as young people increasingly grow to take the helm of climate movements. Voices of youth are an important piece in the transition towards development that mindfully considers the needs of the region in which it exists.

Young people demanded urgent changes of governments to minimize the impacts caused to the environment through various movements. One such name in this fight is Swedish activist Greta Thunberg. Her mission aims at increasing understanding how the human to nature

relationship has deteriorated and the causal interconnections of climate, health, and ecological crises. In her 2021 video entitled, “For Nature”, Thunberg discusses the need for urgent changes in the way we produce food, selected for use, and wasted. She further notes the importance of displaying empathy with animals, details a loss in biodiversity in particular ecosystems, and calls for the reduction of gas emissions.

Under planetary health, climate change requires urgency because of its harmful consequences on human health. The changes that have occurred because of industrialization, a time of drastic environmental impact, are intensifying. Choices that elevate business or development over nature, such as deforestation, or show a lack of knowledge or regard of local surroundings, such as wildfires that are traceable to human activity, have harmful effects on the health of both the planet and humans. We need voices of all ages to contribute to the fight for actions that minimize and resolve climate issues.

Food

Summaries and abstracts could also be clustered by their focus on using education about food to teach topics of planetary health. These were:

- An Interdisciplinary Study With Eighth Grade School Children
- Teaching Nutrition For Healthy Eating, “Food Choices for a Healthy Planet”, an online educational tool to support improved understanding of the complexity and impacts of food choices.

Food is an important aspect of overall health. With the rise of health problems attributed to both obesity and malnutrition, it is integral to teach people about food production as its increasingly industrialized processes, paired with increased global need, contribute to global health issues. Our eating habits interfere with our health and the health of the planet, meaning that the populace should learn how the use of livestock affects local land and how pesticides impact insect populations, soil quality, and can affect local water supplies. Having relevant examples empowers learners to decide for themselves and their local environments with greater context.

To widen the lens, it is important to acknowledge the Industrial Revolution when discussing planetary health. While this period included economic progress and increased consumption patterns, intense alterations to natural ecosystems that ultimately compromised the health of future generations were the consequence (CFHI, 2021). Population growth and exponential consumption of natural resources combined to drive drastic changes in ecosystems, such as deforestation, loss of biodiversity, and the emission of greenhouse gasses. City-based populations end up seeking practical and cheaper foodways, a habit that can contribute to a litany of health problems. Some of these food products bear chemical, biological, and artificial contaminants. Access to food that is rich in essential nutrients is a continued struggle for marginalized populations.

These particular articles allow us to reflect what extent our eating habits interfere with the health of the planet. During a 2021 virtual address, United Nations Secretary Antônio Guterres noted that "humanity is waging a war against nature." When considering the impact of using the environment in an exploratory way without thought to the short and long-term outcomes, the health of the planet is at risk. Agroforestry, family farming, and respect for regional biodiversity are ways to reduce impact on the environment, in addition to supportive government policies to support the people building these systems in each locale.

Schools, as socializing agents, can intervene in this essential knowledge while simultaneously allowing for integrating relevant areas of study to support and further planetary health understanding. Students can better understand the importance of a diet rich in essential elements by increasing their knowledge of nutrition labels. Barros *et al.* presented three recommendations regarding health and climate change (2021). All of them aimed at reducing environmental impacts on Brazilian ecosystems. Notably, two of them addressed the ways we eat: improving nutritional security and promoting the planetary health diet created by the Eat-Lancet Commission. Both ideas point to the importance of initiating biodiverse, locally focused practices, such as incorpo-

rating cultural knowledge and increasing dependence on family farming to accomplish these goals.

Pedagogical Introductions of Planetary Health in Education

There were two research articles with students using playful, sometimes gamified ways in which they gained planetary health knowledge. These were:

- The role of Serious Games and Youth as Co-Designers in Future Healthy and Sustainable City World-Building
- ABCs of Planetary Health: A Children's Book Initiative

If planetary health is going to take on a significant role in the school curriculum, it must command the interest and attention of students and meaningfully activate background knowledge. Both the applications of gamification and didactic materials at grade levels support contextualized experiences and enable relevant problem solving from a transdisciplinary perspective.

Meaningful educational games support the development of complex problem solving. In the first study associated with this topic, they tasked students with specific environmental problems and their associated human health consequences in a simulated setting. This is a low-risk opportunity for students to explore and deepen their understanding of these issues, potential solutions, or the lack thereof. This challenges great minds to seek solutions across lines of culture and discipline as it provides rewards for sustainable choices that construct healthy future cities. In the latter, authors reviewed the creation of an alphabet book centered on planetary health topics to break them down into memorable, accessible terms for the youngest students. Something like this serves to inspire hope, actions to protect future generations, and an early love of and respect for natural systems amongst children.

Teaching Planetary Health in Core Education for Riverside Students in Amazonas

Finally, after the analysis, we turn our gaze to our context of lives and actions, asking ourselves: Considering the incipience of associated curriculum, how should students in rural schools learn about planetary health? Our proposal focuses on this topic in the Amazonas State, supported by doctoral research such as, “Planetary Health and Ethnobotany: Necessary Dialogues for Scientific Education in Riverside Schools in Southern Amazonas State”.

It is our understanding that, for schools to teach planetary health effectively, early introduction and continued reinforcement from pre-k through high school is critical. These lessons become more impactful when reflective of their local environment. Young people in these spaces will grow to handle the future of the planet, therefore, it is essential to combine transdisciplinary strategies that empower students to be resilient and able to fight for issues that are essential to the survival of the planet.

Amazonas is an immense territorial area that includes an exuberant forest, rich in biodiversity, natural resources, and cultural heterogeneity. In this context, discussions of planetary health grow to be complex as they strive to reflect the interests of traditional residents, such as quilombolas and other indigenous peoples, who served as guardians of the rainforest and are subject to existential risks that compromise the area’s biodiversity.

Urgent government initiatives can support the introduction and continued spread of planetary health throughout school and professional learning curriculum. It is necessary to create strategies for educational maintenance, such as investing in continuous professional training and offering didactic resources to schools lacking them. The government could further support these aims by elevating regional foods over imported, valorizing family farming, increasing access to quality health services, improving basic sanitation services, and fostering cooperatives

that include products representative of local biodiversity and that provide an equitable means of income for sellers.

It is our position that scientific education in riverside communities needs to be based on the elements of the territory, biodiversity, and local indigenous knowledge, bridging the strategies of ancient knowledge from local populations with scientific knowledge. A transdisciplinary connection between areas of knowledge, action, and practices adopted by educational institutions should reflect a basic understanding of planetary health and the local environment, for example, choosing school meals made with regional ingredients.

School meals are essential to discuss when thinking about planetary health because of their implications on health, quality of life, and environmental sustainability. In most riverside schools, meals consist of ultra-processed or canned foods. According to local educators, this choice was made in response to food distribution difficulties in the area. It brings to mind the question of the negative impacts to human health as industrialized foods contain significant amounts of preservatives, can have cancer-causing nitrites and nitrates on their ingredient lists, are high in bad fats, and lack essential nutrients.

To effectively combat this issue, valuing regional foods from local farming to provide healthful ingredients for school meals is an option. Changes in eating habits because of choices provided in a school setting normalize an appreciation for local biodiversity besides the benefits to the bodies and minds of the students. With the riverine people, a school meal plan reflective of their local environment would include regional fruits and the main animal protein consumed by this group, fish. Using these foods in everyday meals provided by schools supports the discussion of planetary health throughout the curriculum, such as food sourcing, environments required to supply the food they eat, and facts about animals and predators within the local ecosystem. Another key aspect of the symbiotic relationship between local farmers and schools is the aforementioned field experience opportunity. Farms could take part in

learning by opening their fields for practical and field classes, teaching scientific themes involving food and health illustratively. Combined, focusing on fair sourcing for school lunches can shift food dependence from processed foods to those with demonstrable benefits to human health, provide a strong foundational knowledge of and appreciation for local biodiversity, and might serve as a way for local producers to generate reliable annual income.

Environmental issues in riverside communities and schools in Amazonas State are diverse. However, we should note that most communities have inadequate or non-existent basic sanitation services, contributing to a host of health problems and increasing the pollution of natural ecosystems. Other issues affecting this precious region include deforestation, water pollution because of mineral extraction, air pollution, forest fires, and various implications of building hydroelectric plants. It is possible to address planetary health with these considerations across academic subjects to outline strategies to solve these problems.

Incorporating environmental issues in all levels of education allows for the point of natural resources as essential for all forms of life. Plants, animals and natural systems existing in the riverside scenario are interconnected, thus, able to contextualize in core science education. Taking this approach makes it possible to find solutions that prioritize a harmonious relationship with the planet to guarantee the survival of future generations.

The methodologies for approaching these themes are diverse and possible to be reflected in a transdisciplinary way, primary amongst them: field research, readings, recreational activities, prototyping, activities that build awareness, learning based on local ecological issues, project-based learning, case studies, field classes, and expansion of available and relevant teaching materials.

Each riverside community in the region has its particularities, with schools having the role of adapting to issues within their respective communities in ways that reflect regional production cycles and climatic conditions. Thus, to teach planetary health in riverside schools, there is

no ready universally applicable recipe for all institutions, but transdisciplinary proposals that serve as an inspirational foundation to be adapted for each location.

In Amazonas State, for example, it is essential to reflect on both the general and specific local contexts to address several problems, particularly, that preservation of the Amazon forest is constantly threatened by anthropogenic actions. Knowing that there remain many unstudied animal and plant species within this rich rainforest, this risks the outcome of the local Amazonian biodiversity being lost before it is ever known, a devastating loss for both the local ecosystem and the world. Another consequence of deforestation is the diseases caused by parasites and respiratory issues because of an increase in air pollution.

It is up to schools in these areas of the Amazon rainforest to allow fair dialogues, prioritizing human health, and the health of the planet. Above all, it is critical that public policies and governments reflect the urgency appropriate for prescribed actions and adaptations to amend environmental issues.

Final Remarks

Young people are primed to be the biggest beneficiaries from reducing environmental impacts, and, perhaps, the disproportionately affected if changes in responses to environmental catastrophes do not occur. This review brought about rich discussions of planetary health in basic education, cogitating the place of environmental issues in educational institutions, school curriculum, and continued professional development for educators. It should be noted that schools are privileged educational spaces for approaching these themes with a promising target audience composed of voices that are sensitive to the changes necessary to combat environmental crises.

After systematizing the data, it was possible to verify that planetary health is still an underutilized topic in educational spaces. Few studies were found that prioritize approaching environmental preservation from

the perspective of education as a conduit by which to enliven and empower young people to change their habits in favor of the planet's and humanity's health.

Education that recognizes the reality of the region and incorporates local knowledge enables the broadening of horizons, ultimately creating empathetic individuals who are aware of their role in society and understand their interdependence with natural systems. Additional benefits lie in providing quality scientific education while making important gains for the health and well-being of both humanity and the planet.

It is worth considering the need for more research centered on planetary health in addition to the potential benefits that could come from introducing this topic in core education at all levels. Government strategies prioritizing investment in continually training education professionals would support this approach. This will allow for relevant updates of scientific knowledge provided through teaching materials that align with the most current reality of the planet.

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CHAPTER ONE

Planetary health as a strategy for teaching socio-environmental issues in the (post)-pandemic scenario

Report of school experience in Porto Alegre, RS, Brazil

AUTHOR
Prof. PhD Thaís Presa Martins

My name is Dr. Thaís Presa Martins. I was born in Porto Alegre, in the state of Rio Grande do Sul (RS), which is in southern Brazil. I am a biologist, specialist in environmental management and hold both Master's and PhD degrees in Science Education. For seven years, I taught biology at various levels, moving from elementary School to high school and continuing on to higher education.

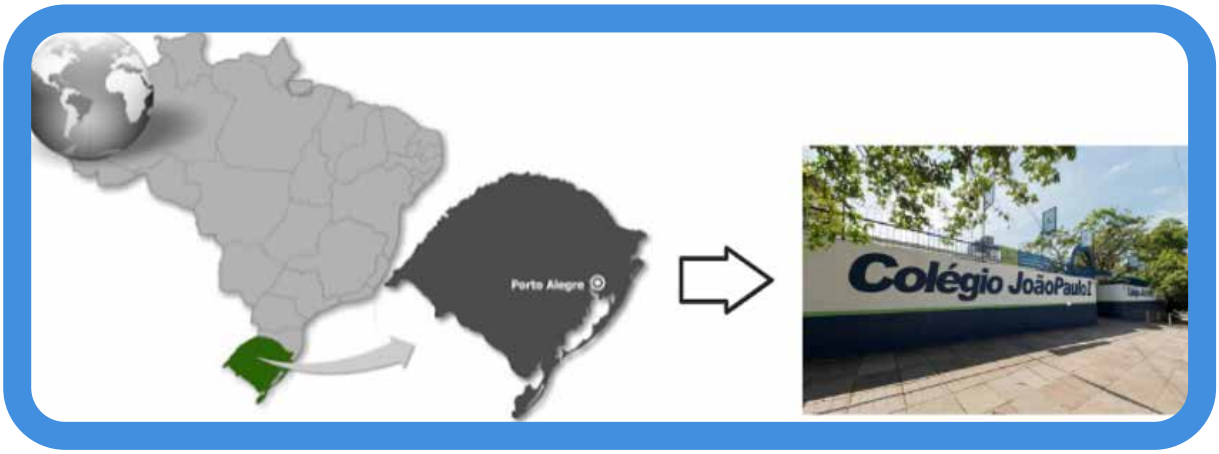
My insertion in the planetary health field occurred in November 2020. I became a member of the Brazilian Planetary Health Club as a PhD student. In 2021, I joined the Planetary Health Studies Group as a researcher and scientific communicator. This organization is linked to the Institute of Advanced Studies at the University of São Paulo (GSP-IEA-USP). Since then, I have dedicated myself to thinking about strategies to address planetary health issues within the context of educational institutions and science curriculum.

For three years, I taught at a private school in Porto Alegre called Colégio João Paulo I Higienópolis (Illustration 1), a school largely serving students in the middle to upper class socioeconomic statuses. Like many other classroom communities, the COVID-19 pandemic hugely affected the way we delivered lessons. Between March 2020 and March 2021, classes adapted to imposed health and closure restrictions, which resulted in online classes. From April 2021 to October 2021, we moved to a hybrid format. Finally, November 2021 found us returning to the face-to-face classwork. As a result, a series of pedagogical practices, such as multidisciplinary projects and field study outings, were affected or outright eliminated.

Our school had a thirteen year tradition called the "Scientific Showcase." Students from early grades up to high school developed group research throughout the school year, all of which were guided by the principles of Scientific Initiation. Each year brought about a fresh theme defined by teaching staff, pedagogical coordination, and school administration. Because of pandemic restrictions, in 2020, there was no Scientific Showcase at the elementary level. When it returned in 2021, it

was solely available online. Finally, 2022 brought the return of a face-to-face format. The agreed upon topic was, “Innovations for the Post-Pandemic World.” Work was guided by professors across disciples of various natural sciences.

Image 1: Colégio João Paulo I Higienópolis, Porto Alegre/RS, Brazil

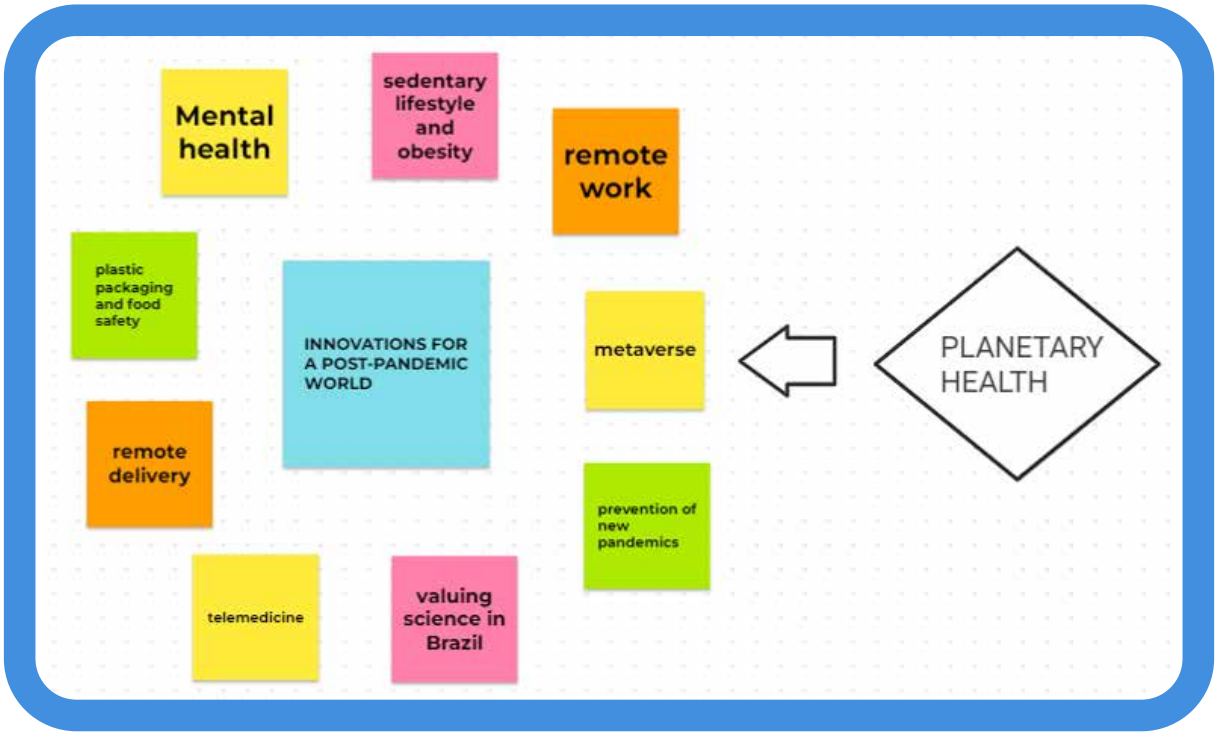


Source: Dr. Thaís Presa Martins (2022)

That year, I addressed the COVID-19 pandemic in biology classes with my three eighth-grade classes, contextualizing it with the reality experienced by my fifty-eight students. Initially, we brainstormed using a mind map on the classroom’s whiteboard. Among the relationships considered and potential research subjects, the most recurrent were mental health of children, adolescents, and health professionals; expanding access to and availability of telework; the increase in sedentary lifestyles and obesity rates; importance of telemedicine; increased demand for online deliveries; increased use of plastic packaging as part of food safety; intensified use of the metaverse; appreciation of science in Brazil during the pandemic; and prevention of new pandemics (Illustration 2).

At the end of this stage, I asked students if they were familiar with the expression “planetary health”; They greeted me with a resounding “no.” I asked what they thought the phrase meant. Most students deduced it dealt with “*the health of the planet*”, “*nature’s health*,” or “*the health of the species*.”

Illustration 2: Mental map about the post-pandemic scenario



Source: Dr. Thaís Presa Martins (2022)

Moving forward with the topic, the goal became encouraging students to consider how and why the pandemic emerged. Further, they had to reflect on how much this emergence can be linked to the degradation of ecosystems, disrespect for other species, and human health and disease. I used the film "The Promise of Planetary Health" to spur discussion (Planetary Health Alliance, 2021).

This film reminds us we are not independent of other forms of life found throughout nature. Its commentary weaves a sophisticated network of relationships between species, environment, and health. It also highlights research in planetary health pointing to human actions as an imminent threat to our own health.

Climate change affects all dimensions of human well-being, including those as integral as nutrition and mental health. There are a host of factors undermining the foundations of human well-being, including: exposure to infectious diseases; extreme weather events; non-communicable diseases; water, air, and soil pollution; and access to clean drinking water. Land use changes, such as deforestation, habitability of the places we

live, a scarcity of drinking water, lack of arable land, and both the quality and quantity of the food we produce also contribute to sabotage biodiversity and interspecies health.

The film concludes that the enormous health gains achieved over the last few decades are threatened by our own transformation of natural systems. It calls us to weave a new fabric with threads of indigenous knowledge, traditions of faith, literature, and arts to reaffirm our spiritual connection with the natural world. Interdependence, equity, abundance, regeneration, and rebirth should be the new values of humanity.

During the viewing session, I paused the film at key points to provoke student discussion about the evolution of species: various ecological relationships; bioaccumulation along the trophic levels of food chains and webs; and atmospheric, aquatic, and terrestrial pollution. At the conclusion of the film, we reached my pedagogical goal of discussing how much we affect the environment, other species, and the planet's ecosystems. We spoke about the feedback generated by these impacts and how they harm our health, particularly emphasizing my students' reality.

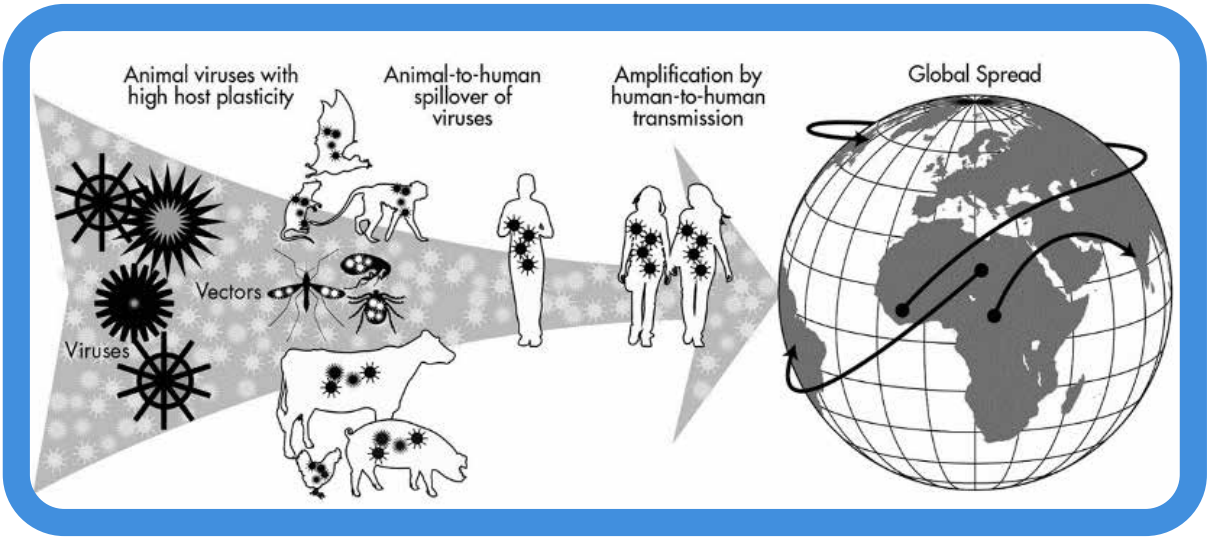
In a later reflection, students reported finding the video complex and fast-paced, however, they could understand how the invasion of animal habitats for food use, in this case, that of bats, could have caused the spillover of the SARS-CoV-2 virus from them to us, originating the disease COVID-19 (Illustration 3).

Here, I realized the students were ready to understand the meaning of planetary health. I presented my simplified concept: "Planetary health is the interdependence between human health and the sustainability of the planet." I later provided a more official definition: The concept of planetary health is based on the understanding that human civilization and health depend on flourishing and wisely managed natural systems, however, natural systems are being degraded to an unprecedented extent in human history (Whitmee *et al*. 2015).

Following this pedagogical path, the students seemed to understand key tenets of planetary health. They did not merely memorize another

cold theoretical concept in an impersonal learning environment that did not provide space for the rich dialogue provided by the adolescent way of seeing the world. They truly learned.

Illustration 3: Spillover of Zoonotic Viruses



Source: Johnson *et al.* (2015)

In July 2022, we conducted a study trip to the Science and Technology Museum of the Pontifical Catholic University of Rio Grande do Sul, MCT and PUCRS, respectively. Our goal was an emphasis on socio-environmental issues: (a) the greenhouse effect; (b) global warming; (c) climate changes and emergencies; (d) types and uses of energy sources; and (e) planetary health (Illustrations 4A & 5B).

Based on their experiences in the interactive museum, I asked students to fill in an activity script reflecting on themes mentioned throughout the exhibits. Afterwards, students were grouped and challenged to create a five minute long podcast with a twofold aim: (1) present and relate the greenhouse effect, global warming, climate change, energy consumption to the concept of planetary health; and (2) promote ongoing actions that can diminish these effects. Equity and access in mind, I pointed students to free podcast creation applications with user-friendly layouts, such as Anchor and Speaker. We discussed using these programs to make podcasts using cell phones, found music that was copyright free for their work, and ensured research sources used in their programs were reliable.

Illustration 4: A) 9th grade class and me in front of the MCT/PUCRS entrance (left); B) Students researching climate change at MCT/PUCRS (right).

Source: Dr. Thaís Presa Martins (2022)

They completed the podcasts in August and presented to me to show their learning. Some works could prove the development of a sophisticated ecological web of relationships, emphasizing the intense negative environmental impact caused by human beings on Earth, particularly since the period of the first Industrial Revolution. In addition, they showed further planetary health research as a promising way to facilitate understanding of human to planet interconnection and the development of concrete actions to strengthen that relationship.

The featured videos from the 9th grade students were “Planetary Health and Other Socio-environmental Issues” and “The Causes and Consequences of Human Interference in Planetary Health.” The 8th year students presented “Planetary Health” as a teaching strategy for socio-environmental issues in a private school in Porto Alegre, Rio Grande do Sul, Brazil.

The eighth graders presented planetary health as a field putting significant effort towards the issues of sustainability and human life from an integrative, transdisciplinary, and global perspective while ensuring to note the reverberating impact of local problems around the planet. Students spoke about a local example to further contextualize the importance of planetary health, the Guaíba Mine Project. The city of Guaíba is located

less than 16 km from the center of Porto Alegre, Brazil. In it, the construction of the largest open pit coal mine in Latin America is in the planning phase. Nearly 4.5 million people would feel the impact of the mine entering the operational phase. The Jacuí River flows into the Guaíba, the primary water source for the population of Porto Alegre's drinking and agriculture needs, like irrigation of rice crops. This water would become increasingly acidic as contamination from heavy metals due to mine wastewater overflow settled into the area. Operating the mine would emit high levels of coal soot that would trigger or exacerbate the incidence of cardiorespiratory diseases in the population, among other problems.

Finally, the video emphasized what we can do to improve the observed scenario. First, government actions, such as prioritizing technologies that minimize greenhouse gas emissions, fighting against deforestation, addressing forest fire prevention, and increasing the use of renewable and clean energy sources were all noted as integral to progress. Second, they presented individual and group actions, such as reducing the use of individual vehicles in favor of public transport or bicycles, when possible. Also emphasized were the choice to consume products that are environmentally friendly, and the Four R's, which remind citizens to reduce, reuse, repair, and recycle as applicable in their lives.

These audiovisual works result from a pedagogical process that took place over a school year. The dissemination of these works can serve as a guide for the development of other educational activities built to expound on socio-environmental and human health awareness. Important to my heart was circulating these productions as a springboard to inspire my self-proclaimed Science Girls to continue dedicating themselves to research, science, and planetary health.

It is my stance that planetary health can be presented as a tool of social intervention for local and global actions to conserve the delicate balance of nature and the quality of human life and as a powerful teaching strategy of socio-environmental issues and health in elementary schools around the world.

CHAPTER TWO

A Multidisciplinary Activity Proposal on Nutrition in Terms of Planetary Health

AUTHORS
Beatriz Sinelli Laham, Luís Gustavo Lopumo Arruda, Sheina Koffler, and Vanessa Goes

The initiative, "Food Detectives: What do We Eat & Why Do We Eat It?" started in 2021 as part of the Brazilian Planetary Health Club's (BPHC) Education Work Group. By then, the Work Group (WG) wanted to establish an educative trail in an outdoor environment that incorporates planetary health related themes. The original idea went through modifications after two events narrowed the activity focus: direct contact with the Municipal Education Secretariat of São Paulo (SME-SP), and the admission of two WG members into the Municipal Food Security Council of São Paulo (COMUSAN-SP).

The contact with the SME-SP happened per an educommunication colleague who reached out hoping to create a teacher training course that would align with the UN's Sustainable Development Goals (SDG) and to submit it for city hall approval at a later date. Because of the convergence between planetary health matters and the SDG, the WG embraced the idea and will help create a graduate course.

As the SDGs are many and the planetary health field is vast, it took time for us to narrow the course focus. One resolution came in the form of two WG members joining COMUSAN. COMUSAN is a participative council that includes government representatives and civil society, providing a forum by which the latter group can advise, supervise, and pressure the former to act on behalf of food and nutritional safety. Therefore, we made a graduation course focused on planetary health and food and nutritional safety education.

Once we determined the theme, we moved on to course development. We drafted a proposal to add two learning objectives to the municipal education curriculum that specifically deal with nutrition, guidance provided by the Planetary Health Alliance: "Describe sociocultural, economic and environmental impacts on human nutrition," and "Examine human food production and consumption patterns compared to demographic shifts." The primary topics covered in class were planetary health, nutrition, climate change in SDG, education in the environmental management process, and educator territories.

However, one concern remained: Brazilian public school teachers are underpaid and overworked. The lack of educational materials about planetary health was a barrier preventing teachers from using the school's vegetable garden. While there was plenty of material on growing the garden, few books explained how to use it as an educational space. This made us realize that providing a single focus in training might not be sufficient. The lack of relevant teaching materials would keep educators from properly teaching topics with their students.

That consideration in mind, aside from the training course for teachers, we produced didactic material that they could distribute to their students to add further context to lessons. While the training proposal was in progress, the idea of adding didactic material was just a draft. We defined that the didactic material would contain the same content as the training course and would involve activities designed to be done at home or in school gardens.

We submitted the course proposal while the teaching material was in development, however; it was not possible to continue the partnership. Discouraged, we continued to work on the rich materials we had already developed while we sought new partnerships to support us in achieving our goals. Thankfully, we found groups and individuals to join our effort, and we were fortunate to receive financial support that made it possible to produce the digital teaching material.

The proposal, which originated in the Education WG, expanded to other interested groups. The Club's Citizen Science WG also embraced it, with this very relevant topic becoming incorporated into the teaching material and educator training course. From that point on, the activities of both WGs walked hand in hand until eventually merging.

We did not restrict our initiative to the BPHC; other planetary health groups got involved and were crucial for its development. The Southeast Planetary Health Club embraced the proposal, actively participating in creating the activities and materials. The Planetary Health Study Group (PHG), based at the Institute for Advanced Studies at the University of

São Paulo, contributed fundraising and help revise the materials; significant group member contributions came from Alisson Machado, Ana Paula Nascimento, Jussara Almeida, Mônica Rocha Gonçalves, and Natalia Pirani Ghilardi-Lopes. Experts from fields including nutrition, citizen sciences, and education evaluated the resources, suggesting modifications and adjustments as needed. Elementary school teachers Marina Marins and Laurence Gilman contributed with suggestions for the overall project, adding their indispensable classroom perspective. Santander Universities supported the production of the booklets through the Pró-reitoria de Cultura e Extensão of USP, and the participation of partners in the illustration, layout, and revision (Figure 1). For the teachers' training, we had a partnership with the USP's College of Public Health, via Dr. Aline Martins de Carvalho, a doctoral Professor who promoted the course, and with the participation of the educommunication student Pedro Gruppeli, who produced a material and presented a lecture on the subject.

The Brazilian Planetary Health Club

Founded in November 2020, the club's first meetings defined its goals, priorities, and organizational structure. It is composed of both undergraduate and graduate students from regions all over the country and has been established as a group supported by PHG members. The BPHC also wrote a manifest, expressing its principles, values, and objectives:

> **Our union, under the name Clube Brasileiro de Saúde Planetária (Brazilian Club for Planetary Health), celebrates foremost, the articulation between people who are interested in building a future that is based on the improvement of people and Earth's health. Not only because of our geography but also because of our histories, we recognize the singular challenges that are imposed by Global Environmental Changes to the peoples and countries of the Global South. (Manifesto for Planetary Health, 2020)**

They made general decisions about the club in assembly with majority voting. Each meeting is moderated and recorded in minutes, respon-

sibilities that are rotated. For its operation, they created committees to focus on internal management tasks and working groups to handle the proposition of external actions. Both committees and WGs report to a single coordinator who takes charge of the organization and proposes the conduction of self-determined responsibilities.

Regarding the purpose of this material, Beatriz S. Laham, who is a biologist and doctoral scholar in sciences currently serving as COMUSAN's counselor, has been the activity coordinator since the WG's inception, aiming to produce an educational activity that would also be useful for monitoring food and nutritional safety in the city. Luís Gustavo Arruda, a science teacher and a doctoral scholar dedicated to environmental education, approached the group in order to suggest the interdisciplinary involvement of environmental issues in elementary school. Sheina Koffler, a doctor in ecology and post-doctoral researcher, sought to incorporate the citizen science approach into the resources as we built them. Strengthening the team, from the Southeast Planetary Health Club, Vanessa Goes, nutritionist, doctoral scholar in food science, activist, and transdisciplinary researcher in planetary health, delighted with the relevance and robustness of the work, besides the pertinence of its scope with her area of research and performance, embraced the project contributing mainly with conceptual and technical support in the food and nutrition area.

Project

The project happened virtually to abide by COVID-19 pandemic restrictions. The planning meetings, material writing, partners contacts, and teacher training were all handled remotely. This method of delivery has several limitations, but one benefit was that it allowed people in different cities, states, and countries to get involved. During the teachers' training, for example, we boasted professors from four of Brazil's five regions. This type of location-based diversity enriched the debates and made it possible to disseminate the proposal broadly.

Created as a proposal for teachers' qualification, the project has grown and, in addition to the educational material designed for students, now includes a support booklet for teachers. Much like the student booklet summarizes the course and the booklet content, we will describe its content before proceeding to a description of the course and booklet.

Booklet

Entitled *Food Detectives: What do We Eat & Why do We Eat It?* The booklet is an educational material designed to support 8th grade students, but is adaptable to other grades, especially in Elementary II. It comprises an investigative didactic sequence, with two cycles of investigation divided into four sections each, which are described below.

The first section, A Walk for Food, corresponds to the guiding stage of investigation-based pedagogy. Students have introductory contact with the subject to stimulate their curiosity and review the rules and methods for accompanying lesson activities (Figure 1). The material contains text that introduces a food categorization system called NOVA, which has the following categories: *in natura* or minimally processed, processed, ultra-processed, and culinary ingredients. Afterwards, the students should go to a vegetable garden, school garden, or an outdoor space similar to a farmer's market to reflect on their diet habits. The goal is to encourage students to discuss the food they eat while considering its origin and classification.

The second section, Food Detectives, presents the first investigative question: What do people in my local area eat? Students are instructed to act as citizen scientists. To support this stage, they are provided with a text on science and research ethics (Figure 3). To conduct the research, students must interview an adult in the area where they live, by using the National System for Food and Nutrition Surveillance questionnaire as a basis. It includes questions concerning eating habits. They ask about specific categories of food consumed on the previous day by the respondent, some of which included fresh fruits, sugar-sweetened drinks,

Figure 1: Illustration from the booklet, representing food diversity at table and people around it.

Artwork by Fran Matsumoto (2022).

Figure 2: Illustration from the booklet, representing the peer-reviewed and scientific methods of meticulous observation and measurements

Artwork by Fran Matsumoto (2022).

beans, or salty snacks. Using a standard and validated survey form ensures the quality of the data collected, which can also be used for local food and nutritional security surveillance. Together, following the interviews, the students are to analyze their results by synthesizing their learning into tables and graphics that show their findings.

The third section, The History of Food in Cities, corresponds to the second cycle of investigation, starting with the question: Why do people in my local area consume these foods? To answer this question, students read a text that describes how food in cities is influenced by historical, geographical, and cultural aspects (Figure 3). The text also introduces the concept of food systems, connecting them to environmental impacts, food security, and food sovereignty. In order to guide the reading, the text is interspersed with six questions that address important issues to spark discussion and critical thinking about foodways.

Figure 3: Illustration from the booklet, representing two families in the same city with different diets

Artwork by Fran Matsumoto (2022).

Finally, section four, Communicating our Experience, is the moment of reporting the investigative journey. Unit knowledge culminates in a social media post prepared by the students in which they share their findings in response to the two investigative questions (Figure 4). This step is important both to synthesize the knowledge built throughout the sequence and multiply it, using platforms with which the students are already familiar to disseminate their knowledge.

Figure 4: Illustration from the booklet, representing students investigating food and tending a garden.

Artwork by Fran Matsumoto (2022).

It is worthy of note that five 8th grade classes piloted the material in a private school in São Paulo. Both before and after the application, the teacher contributed by offering reviews, suggestions, and observations about the provided material. We warmly acknowledge that gaining the teacher's collaboration was essential for the material to be suitable for classroom use. The booklet is currently being published and will soon be released in an open-access format. We hope to produce physical copies of the material for schools as funding is provided for this purpose. Figure 6 represents the cover of the booklet..

Teacher Guidebook

The teacher guidebook is a support material for implementing these activities. Starting with a wide-ranging introduction, which presents concepts of planetary health, food safety, citizen science, and evidence-based education, it contextualizes the booklet in the school curriculum, presenting the Common National Curricular Base learning objectives encompassed. It is worthy of note that these resources seamlessly incorporate science, history, geography, Portuguese language, and mathematics, which allows for collaboration between educators in these areas.

After the introduction, the guidebook describes the four sections of the booklet. For each section, six topics are listed: activity description, didactic resources, and activity duration; objectives of the proposal; curricular learning objectives; evaluations; suggestions for those who teach; and materials for further understanding. Last, there is a glossary with important words and terms present in the guidebook and booklet. We used the content of the guidebook as the basis for the teachers' training course, described below, and revised under participating teachers' feedback.

The Teacher Training Course

The teacher training course, entitled, "Promoting Planetary Health through Food and Nutrition Education: a Transdisciplinary Education Proposition for Elementary School Teachers", was offered in partnership with the USP School of Public Health as a diffusion course by the *Pró-reitoria de Cultura e Extensão* (Figure 6). We would like to emphasize that the partnership with the university, specifically Dr. Aline Martins, contributed to the acknowledgment of the course and ensured the certification of the attending teachers, a relevant aspect for their education and career progression. The target audience were public school teachers from Elementary Education II, and the speakers were the four authors of the text. This was accompanied by a lecture from Pedro Gruppeli, a graduate student in educommunication, which addressed communication of one's experience.

The aim of the course was presenting the following subjects: Food and Nutritional Security and Sovereignty through understanding the NOVA classification of food and food systems; Planetary Health (connecting environmental, health, economic and sustainability issues aiming at healthy and affordable food for everyone); and citizen science, Investigation-based science teaching and educommunication (discussing the reliability of science and working on science education through a local food security investigation project). In addition, the classes intended both to support the implementation of the booklet at school and to discuss possibilities of applying and adapting the presented proposal in different schools.

Figure 5: Course opening slide, presenting its title, the lecturers' names and the logos of the sponsoring institutions.

Source: Elaborated by the authors (2022).

The aim of the course was presenting the following subjects: Food and Nutritional Security and Sovereignty through understanding the *NOVA* classification of food and food systems; planetary health; and citizen science, Investigation-based science teaching and educommunication (discussing the reliability of science and working on science education through a local food security investigation project). In addition, the classes intended both to support the implementation of the booklet at school and to discuss possibilities of applying and adapting the presented proposal in different schools.

The total course load was 30 hours, distributed over four weeks. Training consisted of eight two-hour meetings, conducted online, during July and August 2022, corresponding to sixteen hours of synchronous classes. The course also included fourteen hours of asynchronous assignments. The description of the course contents is shown in Table 1.

Twenty-seven people from four of Brazil's five regions enrolled in the course; amongst them, we selected twenty because they fit the target audience and they provided all integral information for registration and

certification. Only eleven of the twenty registered participants attended the course, being present in at least 50% of the classes.

Table 1. Content distribution over the training weeks and meetings.

WEEK	MEETING DATE	TOPICS
Week 1	July 11th, 2022	Conceptual presentation: Planetary Health, NOVA food classification and climate change in the context of UN/SDG.
	July 13th, 2022	Conceptual presentation: Citizen science, education in the environmental management process and educator territories.
Week 2	July 18th, 2022	Didactic sequence presentation and learning goals for section 1.
	July 20th, 2022	Didactic sequence presentation and learning goals for section 2.
Week 3	July 25th, 2022	Didactic sequence presentation and learning goals for section 3.
	July 27th, 2022	Didactic sequence presentation and learning goals for section 4.
Week 4	August 1st, 2022	Didactic sequence adaptation to school reality.
	August 3rd, 2022	Didactic sequence adaptation to school reality and peer-review.

From the participating teachers' common thoughts, we can highlight some important points about the course and the project altogether. Some teachers mentioned the presentation of the booklet bothered them as they felt it restricted the approach possibilities of the subject. We emphasize that the idea of producing educational material to be used in the classroom was not meant to replace the teacher's role, but to provide a starting point that can be used as a reference to reduce the teacher's workload. We concede this format may not be ideal for all teachers. These teachers were very participative throughout the course

and presented several ideas to adapt the booklet to their school reality, showing that the material did not hinder the use of the course.

A second point worth noting is teachers from kindergarten and early elementary school participated in this process. Although the booklet is geared toward elementary school II, the teachers also shared adaptation possibilities for younger students. For example, one teacher, who teaches primarily four- and five-year-old students, proposed to adjust the didactic sequence to discuss nutrition and waste while keeping the idea of the research in section two. In order to organize the results, the students attach little squares above a certain food category, forming a visual chart that communicates data to students who may not have mastered reading yet. For us, this reflects the potential to explore the topic and the material with different audiences.

Finally, we emphasized the potential of engaging various agents in implementing the didactic sequence in schools. In the final assignment of the course, we requested the participants identify people who could support or work together for the development of the proposal in their school community. The answers included janitors; family members; math, history, geography, communication and languages, informatics, chemistry, art, and physical education teachers; cafeteria staff; garden staff; and school dietitians. This reinforces the transdisciplinary potential of the proposal and that teachers recognize this.

We evaluated this first experience as positive, showing that nutrition and food safety can be a good starting point for planetary health in formal education through transdisciplinary work. There was great receptivity from the teachers, who said they were interested in the subject and concerned about the food of their students. During the course, multiple teachers planned to adapt the activity to an investigation of their students' diets. Although activities like these can spur high student engagement and support a change in habits, we emphasize that the activity seeks to discuss the food issue beyond the health issue. Thus, we sought, over the course, to reinforce the importance of a transdisciplinary vision and the proposal

of planetary health as enrichment. At last, we also verified an acute interest in hands-on learning activities; using a citizen science protocol in which students participate in the collection and interpretation of data seems promising to promote scientific education and culture in schools.

Final Remarks

When the time is of ecological, epistemological, and social crisis; when these crises have been built in history and geography; when scientific and climate deniers triumph; and when education is hindered by hunger, merely transmitting new ideas is inadequate. We need to be aware of the processes of both scientific production and the production of knowledge itself and include diverse voices in our educational materials. In Boaventura Sousa Santos' words, we need an education for "A more equal, more just relationship that makes us learn the world in an edifying, emancipatory, and multicultural way. This will be the ultimate criteria of good and bad learning" (p. 545, 2018). Amidst the multiple and complex challenges we have as humankind in the Anthropocene, the urgency of making profound paradigmatic changes at all scales reigns supreme. We need to quickly re-signify our values and reinvent our relationships, ways of life, systems at all scales.

Without models or instruction manuals to accomplish such a mission, we can only imagine, create, experiment, and disseminate feasible solutions together. Within this context, education is a powerful tool that also needs to be reinvented, and any initiative in this area, properly grounded, is valid. Be brave! Onwards!

CHAPTER THREE

Planetary health as an Undergraduate Course in Biological Sciences:

A Microcourse to Discuss a Case Study and its Complexity

AUTHORS
Beatriz Sinelli Laham, Isabela C. Barbosa-Viadanna, and Luís Gustavo Arruda

Abstract

This is a report on the application of a Planetary Health Alliance (PHA) case study in the Planetary Health Education framework (PHE) in an undergraduate complementary activity. It was a proposal contextualized in the PHA and Institute of Advanced Studies at the University of São Paulo (IAP in its Portuguese abbreviation) ambassador programs, seeking to implement the PHE using the planetary health education materials already made available by the Alliance. The case study was presented as a remote microcourse, using the Google Meet platform, lasting six hours, during a congress at the Institute of Biosciences of USP, organized by the University's students (STBio - Thematic Week of Biology), upon the case study, "*Putting Food Needs First: How Alternative Proteins Could Save Madagascar's Endangered Biodiversity*". Fifteen students participated, mostly undergraduates in biology. Throughout the course, we sought to: i) understand the five domains of PHE in the case study; ii) possibilities of research in biology, according to the interests of students, with dialogue from the perspective of planetary health; and iii) discussion of proposals for action for planetary health, such as use in clubs, scientific outreach, or university extension. The results of the evaluations suggest that the course presented the integrations between the domains of the PHE, also showing a demand for understanding the integration of the domain on equity and social justice to public policies for environmental conservation and, therefore, for planetary health.

Contextualization

The publication of the Planetary Health Education framework (Guzmán *et al.*, 2021) shed new light on the integrated insertion of themes on sustainability and social-environmental systems in education. Understanding the syndemic character of COVID-19 shows this exact conceptual stance based on the integration and reciprocity of phenomena of different scales and natures in the determination of human and planetary health. Regard-

ing it, according to the correspondence by Horton (2020), the prefix sin is considered as an opposition to a reductionist treatment for the SARS-CoV virus: for this, an integration between broad prevention, within public policies, is needed as well as post-exposure demands, especially given the unequal socioeconomic effects of the disease.

Such an approach resonates the perspectives on planetary health, placing the logic of interdependence between health and human well-being in interaction with the health of the environments it occupies. From this perspective, Whitmee *et al.* (2015) present three broad categories of challenges to promote human health in the face of environmental challenges and uncertainties: imagination (conceptual and empathy failures), research and information (knowledge failures) and governance (implementation failures).

Faced with this integration, from an interdisciplinary pedagogical perspective, the Planetary Health Education framework (PHE) highlights the possibilities of operationalizing a teaching that can overcome the presented challenges. The articulation of knowledge in the Anthropocene and Health domains, Construction of movements and Systemic change, Systemic thinking and complexity, Equity and Social Justice and Interconnections with Nature is proposed as a unification between the local social-environmental conditions, their learning objectives, and the planetary challenges - immersed in a global agenda of priorities. Seeking to operationalize these premises, a pedagogical intervention was proposed, based on the case study by Duff *et al.* (2020), at an event focused on life sciences.

Activity Design

The microcourse was proposed stemming from the collaboration between participants of two distinct planetary health ambassador programs: the Planetary Health Campus Ambassador from the PHA, and the Planetary Health Ambassador Program of the Institute for Advanced Studies at the University of São Paulo (IEA/USP). Both programs include people who are

protagonists in a network of specialists who support and promote planetary health, encouraging them to make proposals and actions for the propagation of the theme (Figure 01). Concerning the latter program, two of the authors, Isabela and Luís Gustavo, were part of the Communication Working Group (WG), while Beatriz took part in the Education WG. During her graduation, she had integrated, in 2012 and 2013, the Organizing Committee of the Thematic Week of Biology at the University of São Paulo (STBio). STBio is a university extension project led by undergraduate students that aims to communicate and disseminate science. In 1998, it was exclusive to USP students, however, from 1999 onwards, registration opened to the public. Today, STBio is one of the largest undergraduate congresses in Brazil. The program includes courses, mini-courses, micro-courses, exhibitions, and competitions. In 2020 and 2021, the event took place remotely because of the COVID-19 syndemic.

When she joined the ambassador programs, Beatriz already had a proposal to conduct a course during the event. Both the current organizing committee who accepted this proposal and colleagues, Isabela and Luís Gustavo, agreed to develop and administer the activity together. The Organizing Committee (OC) defined the course workload, at which time, it was possible to start the elaboration of the classes. The educational resources of the collection on the Planetary Health Alliance website were used, specifically, the case studies. Finally, one case was selected for further analysis, because of its similarities with the current Brazilian context and its parallels with the COVID-19 syndemic. The need to relate planetary health to the work field of those enrolled was also raised, highlighting the transdisciplinary potential of the theme and outlining possibilities for involvement with the theme.

In a broad view, the union between the proponents, participants in the ambassador programs, organized from the call for proposals, by the OC of STBio, materialized as a horizontal space that afforded peer-to-peer collaboration. It promoted protagonism as a critical and reflective exercise in relation to planetary health and integrating the domains of its

associated framework, as well as the practical possibilities for implementing these perspectives in the professional practice of young people in initial training. In the following section, the activity and materials involved are described.

Figure 1: The authors and their backgrounds.

Beatriz Sinelli Laham

Bachelor and licensed in Biological Sciences at USP, SP, she participated in the ambassadors in Planetary Health 2021, IEA, USP, in the education area, and in the planetary health alliance campus ambassador program. Together with Luis Gustavo, she manages the profile @extensaonatural, with scientific dissemination integral sustainability. She is a doctoral student at USP, researching on education on climate change.

Isabela C. Barbosa-Viadanna

Bachelor in Biological Sciences at UNESP, Botucatu. She met Beatriz and Luis Gustavo through the Ambassadors in Planetary Health 2021, IEA, USP, acting as a commissioner for the theme through the profile @saudeplanetariabtu on Instagram. She is a master's student at UNICAMP with an emphasis on Cell an Tissue Biology.

Luis Gustavo L. Arruda

Holds a bachelor's degree in Biological Science with a focus on teaching in general science at USP, SP. He participated in the Planetary Health Ambassadors 2021 program, IEA, USP, acting as a communicator of the theme. He also manages the university extension profile @extensaonatural, and has experience in the field of environmental education. He is a doctoral student at USP with an emphasis on Botanic Teaching.

Source: Created by the authors (2022).

Activity Description

In view of the need to present the topic and take the discussion on planetary health to undergraduate students, this group developed a

microcourse based on the case study "*Putting Food Needs First: How Alternative Proteins Could Save the Threatened Biodiversity of Madagascar*" (Duff *et al*., 2020). The case explores the underlying factors behind lemur hunting on the island, highlighting socioeconomic aspects, the food insecurity scenario, and the resulting health impacts. The six-hour course was offered on October 11th and 12th, 2021, for both undergraduate and graduate students. Because to the syndemic period, we held the course virtually using the Google Meet platform.

Concerning the development of the material presented during the microcourse days, the group met in periodic virtual meetings. As assessment materials, we developed a diagnosis of previous knowledge about planetary health and an evaluation for the end of each day. To support the theoretical discussions, we developed a slide show for each day. We prepared the slides that included theoretical content to present planetary health and its applicability, exposing the integrations of the PHE framework with multiple fields of knowledge on this theme. During the course, participants enjoyed interactive activities, such as those featured in Figures 2 and 3.

We recommended participants answer an initial questionnaire to assess their level of knowledge and involvement in the subject (Appendix A). In addition, it was suggested that they watch the video, "*The Promise of Planetary Health*" if they had not already. Considering the possibility that some participants might not know about planetary health, the video became a pre-introduction on the subject.

On the first day of the micro-course, the participants created a word cloud using the Mentimeter platform (Figure 2), with concepts that define planetary health in its conception. The theme was then presented, starting with the presentation of the video, "*The Promise of Planetary Health*", followed by a brief discussion of the prominent points.

Then, understandings of planetary health were presented, using COVID-19 as a contextualizing topic. Using the dimensions of the PHE

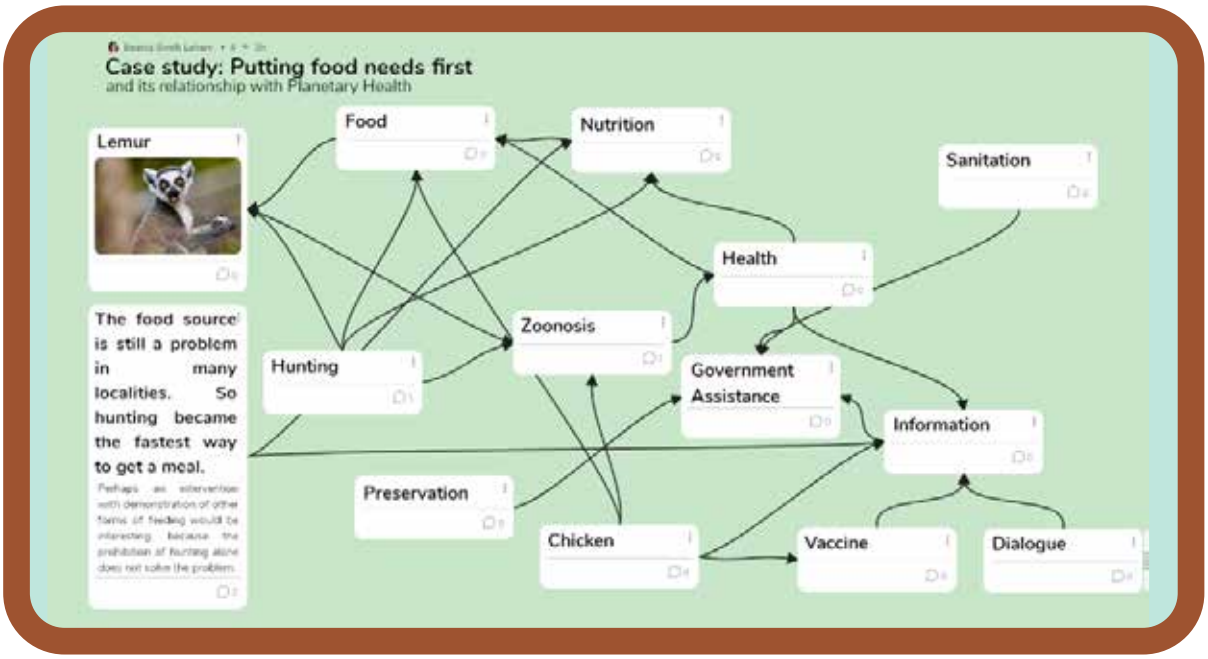
Figure 2: Word cloud generated on the *Mentimeter* platform (2021). Participants were asked about three concepts that define planetary health. The size of the words is proportional to the number of mentions.

framework, we related them to the syndemic scenario. The major theme of the theoretical part was the presentation of the case study "*Putting Food Needs First: How Alternative Proteins Could Save Madagascar's Threatened Biodiversity*" (Duff *et al.*, 2020). The initial presentation of the case study, in Portuguese, ensured uniformity in understanding the situation on which the reflection was proposed: the visualization of the five domains of PHE in this example.

We divided the discussion groups considering the period of graduation they were in, the university they attended, and gender, so that all groups represented students from different levels of training, universities, and included mixed genders. The main issues raised in the discussion were about the outcomes of climate change on human health and transversal topics for planetary health. Each group recorded their reflections using the Padlet platform, highlighting the relationships between relevant aspects (Figure 3).

At the conclusion of the microcourse, we sought to present suggestions for further reading and actions already underway for planetary health,

Figure 3: Diagram generated in *Padlet* (2021).



It portrays the discussed interconnections, each arrow, between the themes during the discussion about the case study published by Duff *et al*. (2020).

such as the PHA itself, the Planetary Health Study Group (IEA/USP), ambassador programs, and clubs who mission align with the goal of maintaining a healthy planet. As a last step, we proposed a call to action. Students would compose a social media post with the goal of disseminating what we discussed during the activity. We additionally encouraged students to suggest possibilities to incorporate planetary health into their research. During the closing, the students proposed the creation of an IB/USP club for implementing university extension actions for planetary health, however, at this writing, the club has not been formed.

Evaluations

We considered several approaches to evaluate the microcourse: a pre-test, a test at the end of the first day and a final test. In addition, the records of the discussions on the virtual wall platform, Padlet, were used as a subsidy for reflections on the development of activities. We developed the questionnaires for the micro-course, and while question types varied by administration, they included open-ended questions, multi-

ple-choice questions, and Likert scales. We aimed the evaluations to assess the conceptions of planetary health, in all applications, as well as on fulfilling expectations, in the intermediate and final questionnaires.

Results

Open-ended questions

In the initial survey, participants' expectations were asked. Most of the answers were generic, such as "good" or "the best possible", although some presented specificities related to planetary health, such as understanding of the concept, related public policies, and its possibilities of practical application.

The intermediate testing administration included a question concerning "doubts, criticisms and suggestions." Even with only four responses among the sixteen participants, all had a complimentary character, highlighting concepts like the integrative view of planetary health and pedagogic strategies about mediation in groups and proposed interactions. Negatively, only one technical aspect was highlighted, regarding the low volume of a presenter's microphone.

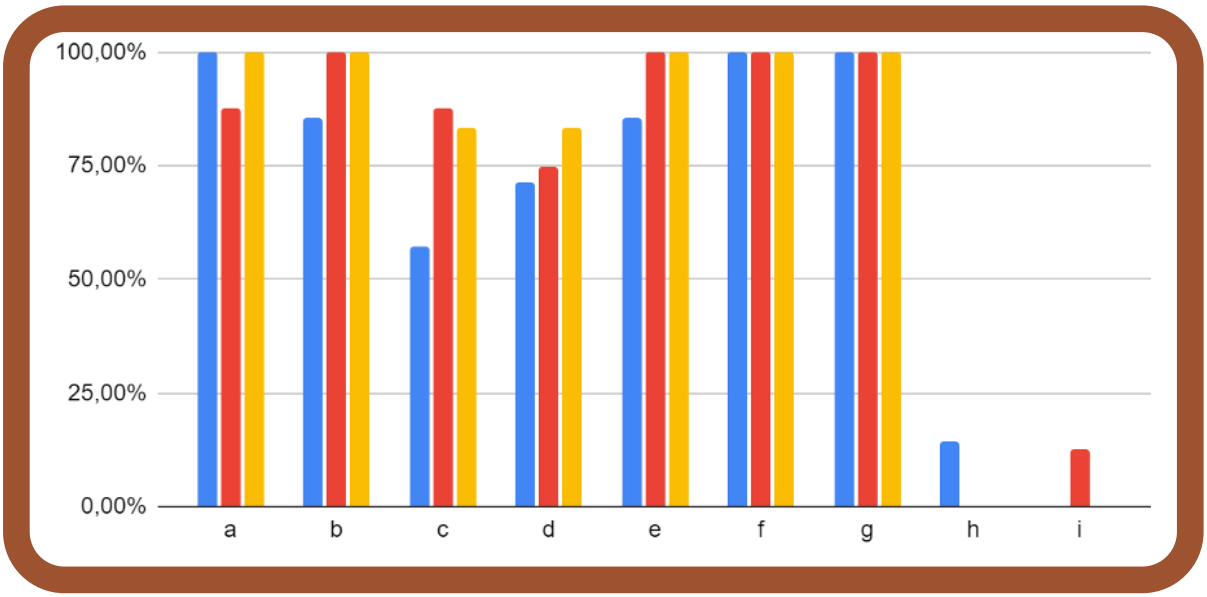
In view of the final evaluation, when asked if expectations were met, all six answers were affirmative, the highlights of which included: conceptual comprehension of knowing the relationships between areas of knowledge in planetary health and group dynamics, especially those that presented possibilities for application practice of the approach. This evaluation also allowed for feedback; the responses expressed they enjoyed taking part in the course, appreciated the spaces created for interaction, and noted the protagonism of those who participated.

Questions with closed answers

The multiple-answer question presented the statement, "*They are consistent with planetary health...*", to which statements were presented for judgment by the participant. It is noteworthy that there were no important differences in the number of mentions of each of these answers,

even though, in the final questionnaire, no incorrect answer was shown. The summary of the answers is in Figure 4.

Figure 4: Frequency of responses to the question "*are they consistent with planetary health*" in the initial, intermediate, and final assessments



Source: Created by the authors (2022).

The alternatives were: a) It is a field that studies the impact of human beings on ecosystems; b) Identifies the risks that interventions may pose to the survival of humanity itself; c) Any professional can contribute to planetary health studies; d) Mental health results from epigenetic processes that integrate genetics, society and environment; e) Diseases such as obesity and malnutrition are related not only to food but also to climate change; f) Current urban design must be concerned with extremes of heat and air pollution; g) Planetary health understands human health as intrinsically linked to the health of the environment; h) The growth of the human population and the acceleration of socio-economic activities do not have a great impact on the environment; i) The dissemination of knowledge gained by the scientific community is of little importance in planetary health

Regarding the scaled questions, an ANOVA found we observed no significant differences between initial and final questionnaire scores. Still, three interesting patterns were observed and are explored below.

The first scenario revealed an increase in the average score and a greater number of answers "I completely agree" for the statements related to four of the five dimensions of the PHE framework, namely: construction of movement and systemic change; systems thinking and

complexity; Anthropocene and health; and interconnection with nature. From another perspective, there was a decrease in the average score and an increase in disagreement concerning the statement regarding the Equity and Social Justice dimension. These results may suggest that the course clearly presented most dimensions of the PHE framework, except for the dimension of building equity and social justice. They may reveal a problem in the questionnaire's formulation, which could have failed to capture the participants' full understanding of this dimension.

A second scenario was based on the decrease in mean scores, but with an increase in variance, observed in one item on Anthropocene and health and in the question discussing climate change and health, specifically, its impact on noncommunicable diseases, infectious diseases, and mental health. This scenario may suggest that the course generated elements for the participants to disagree more frequently than at the initial moment, since the average scores decreased, although there was an increase in the data dispersion.

Finally, the course may not have influenced participants' initial conceptions about these topics as the scores of the two tests were the same, with 100% of respondents noting that they "completely agree", about the impacts of climate change on food and on conflicts and migrations. This could be because of the deep knowledge base of the participants.

Virtual Wall

Virtual collaborative tools, such as Padlet and Mentimeter, were part of distinct moments in the micro-course. They are interactive resources for recording discussions and summaries. The students used a community-created mural to better understand the finer points and larger themes of the case study. "The case study shows us the importance of using interdisciplinary in the analysis and resolution of environmental problems," as stated by one participant on the virtual wall.

Still faced with this integration, the implication for decision-making on related topics was highlighted, such as the direct participation of the

local population, as clear in the record:

> **"This article precisely demonstrates how, through public policies that did not aim at intermediation with the local population, they actually led to a greater dissonance between this and the surrounding ecosystem."**
> ***—Participant B, posted on the wall***

> **"There is no conservation if we do not consider the human factor. Policies and actions must be developed WITH people, taking into account the specificities of each context. People are not affected in the same way by social-environmental problems and *we must mainly take into account traditional communities, which are more socially vulnerable.*"**
> ***—Participant C, free translation, posted on the wall***

In this way, the orientation towards popular participation becomes obvious, with particular attention to the construction of equity and social justice, in implementing collective actions and public policies for the advancement of planetary health. Seeking to highlight actions in this sense, the last mural built also exposed possibilities.

The purpose of this mural was to highlight various actions, projects, and initiatives for the construction of planetary health. The creation of a local planetary health club was discussed, reading materials were shared to deepen teaching in its critical and participatory aspects, and also, the launch and continuation of scientific outreach and university extension initiatives.

Final Remarks

Planetary health is an emerging concept in Brazil, and wide communication and dissemination are important to ensure that it is not a topic solely restricted to academic circles. Creating and promoting courses that address the theme is a way of expanding the debate, contributing to the

consolidation of the field in the country. This chapter describes the development and application of a planetary health micro-course, which can serve as a guide for implementing similar initiatives and expanded courses.

Starting from existing materials, such as those published by the PHA, the possibility of quickly building integrated teaching-learning spaces in different contexts becomes clear: both in using materials already developed and validated, such as in the case study by Duff *et al.* (2020), as well as adapting these materials to the PHE framework proposal and the interests and possibilities for action of the audience. In this way, we encouraged researchers and professors to bring similar initiatives to other places, institutions, and regions of the country.

In view of the evaluations, an affective involvement among participants regarding the theme is inferred, since the contributions of the various fields of knowledge to the construction of planetary health were clear. Thus, the activity promoted the active involvement of those enrolled with the theme, encouraging actions in different formats, involving different areas of knowledge, and in as many educational spaces as possible. In addition, this highlighted the interconnections between the domains of the PHE framework and the perspectives of the case study.

The domain of equity and social justice was particularly debated, although the average scores of the questionnaires do not accurately point to a greater understanding of this aspect and the relationship between humanity and nature. In contrast, its insertion in the debates of virtual murals was expressive, especially in relation to the creation of public policies of environmental conservation that can integrate the orientation for environmental justice. Such a result may suggest, therefore, a failure of the questionnaire to record the perceptions associated with this domain.

In establishing emerging concepts, there is an opportunity to monitor the evolution of the perceptions of those who learn from the beginning, aiming to identify key points for exploration in pedagogical initiatives. As with educational materials, we must do this monitoring through consistent and validated protocols, which allow verifying if the learning objec-

tives are being achieved. The evaluation conducted in this study, although limited, may also suggest future protocols, especially regarding the variables addressed, which seek to highlight the relationships between human and non-human systems, between health and the environment, and between different sectors of society.

CHAPTER FOUR

Nature Science-Based Education Promoting Health in Protected Areas in Brazil

Lessons from the Project Coastal Ecosystems

AUTHORS
Alana Marques Silva Muniz, Beatriz Sinelli Laham, Camila Lopes Lira, Donovan Humphrey de Nardo Baptista Condessa Franco, Luís Gustavo Arruda, Marcos Samuel Macedo, and Maria Carolina Novaes

In the upcoming chapter, we aim to articulate an educational proposal centered around the global climate change theme. With transdisciplinarity as a lens to view the complexity of the theme, the activity described involves agents from different sectors: higher education, protected natural areas, and basic education. Given the purpose of university extension assigned to public higher education institutions, as well as the legal apparatus supporting educational actions in non-formal spaces, this activity is anchored in the articulation between conservation efforts in situ and innovation in teaching-learning processes in basic education.

Background

The Global Climate Change Trail is an educational activity conducted in an outdoor learning environment, conceived and conducted by the Ecossistemas Costeiros Project in São Paulo, Brazil. The Ecossistemas Costeiros Project is an extension and research project developed by the Institute of Biosciences and the Science and Technology Park of the University of São Paulo. It was created in 1997 by USP Prof. Dr. Flávio Berchez and collaborators with the initial aim of raising awareness among tourists at Anchieta Island State Park (PEIA) about the effects of visitation activity, which were compromising the natural recovery of marine species in local habitats.

Thus, the first models of coastal and marine environmental education developed by the group were created: the Underwater Scuba Diving and Free-diving Trail. Since then, the group has expanded and merged itself, creating new educational models, connecting with new partners for its development, training monitors for its application, and reaching new schools in the region. A network was then formed, composed of i) the University, which promotes the creation and evaluation of the models proposed by the group; ii) the Protected Area (PA) of the State of São Paulo, which intermediates the group's actions with the public schools in its surroundings; and iii) the elementary schools themselves, which welcome the network's initiatives, promoting spaces for dialogue and

knowledge exchange among teachers, as well as in the planning of field trips with the students.

Around 2015, based on the need to discuss climate change issues while providing basic coastal and marine environmental education, a model of critical, emancipatory and cooperative education was created: the *Global Climate Change Trail* (GCCT). With the general goal of supporting basic public education on the theme of global climate change, the GCCT uses natural areas as spaces for environmental awareness and conceptual learning, especially in the involvement of understandings about outdoor learning.

GCCT and Planetary Health

Although conceived before its publication, it is possible to identify characteristics in the GCCT that directly refer to the five dimensions of the Educational Approach for Planetary Health, proposed by Guzmán et al. (2021). Namely, the very theme of the GCCT enters the dimension "*Anthropocene and Health*," which addresses the anthropogenic causes of climate change and its impacts.

By establishing a network that connects the university, protected areas, and basic education schools, with a priority on the public education system, the Ecossistemas Costeiros Project aims to reach populations vulnerable to climate change. This initiative contributes to their empowerment by providing information aligned with the dimension of 'Movement building and systemic change.' While the project does not directly address issues of inequalities and structural injustices, it is dedicated to promoting involvement in the domain of 'Equity and social justice.' This commitment is evident as the project focuses on the public education network, which typically has fewer resources and less structure compared to private institutions in this sector within the country

Through the mobilization of this network of socio-environmental agents, Ecossistemas Costeiros promotes synergy between the benefits to human health derived from a protected natural area within the terri-

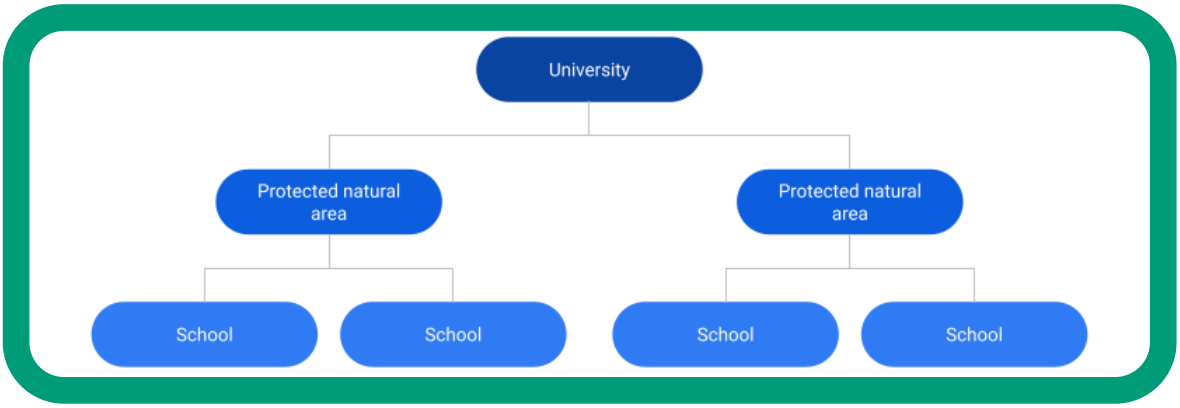
tory. These benefits include the maintenance of air quality, water safety, temperature control, provision of space for physical exercise and socialization. Engaging in activities within the natural environment becomes an opportunity for the development of experiential learning. Starting from photosynthesis as the unifying theme, GCCT addresses the carbon cycle, fossil fuels, climate change, and environmental impacts, articulating the relationships between local and global agendas regarding priorities in education. In this exchange, students exercise the construction of "Systemic and Complex Thinking", promoting the association of concepts often presented separately, such as the need for mitigation actions for GCCT from integrated conservation efforts.

In a comprehensive view, given the gentrification processes, and consequent elitization of access to natural spaces, the focus on public systems acts to strengthen the interconnections with nature. The realization of the activity in a natural environment, in urbanized and peripheral regions with restricted access to nature, contributes democratically to the promotion of this construction of interconnections, a central dimension in *Education for Planetary Health*.

Our Network

By articulating different social agents, a network was formed (Figure 1), composed of three pillars: the University (USP undergraduate students),

Figure 1: Diagram representing the relationships established between different socio-environmental agents in the realization of the Global Climate Change Trail.

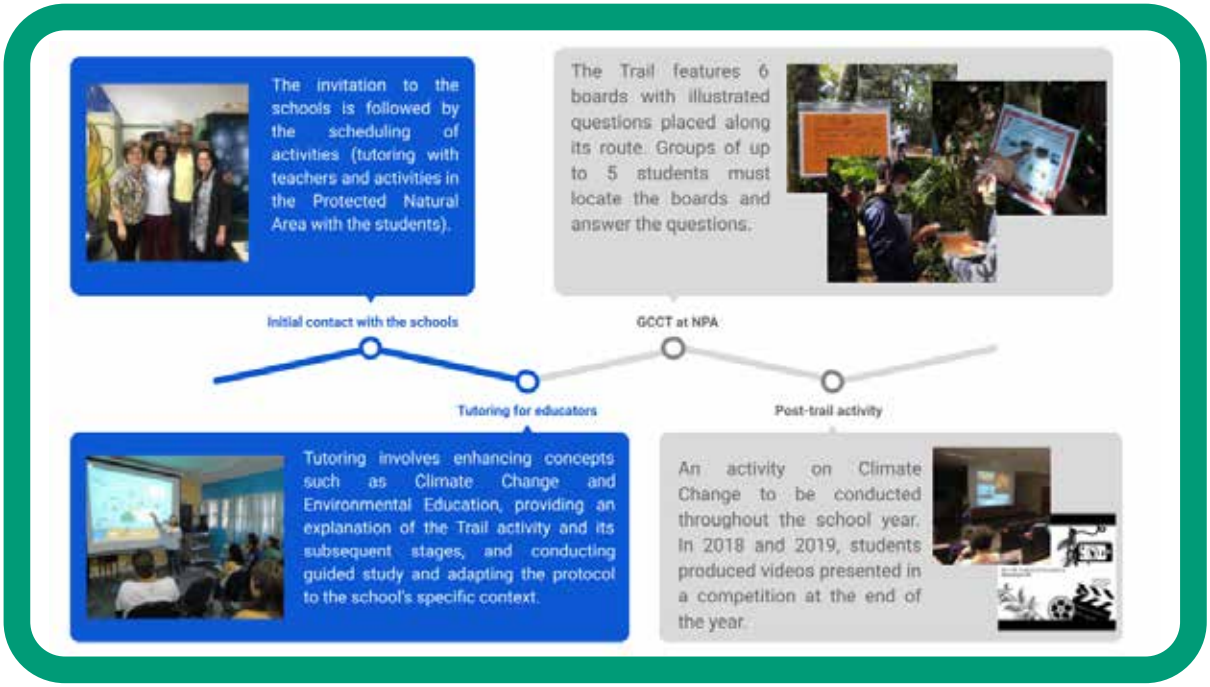


Source: Elaborated by the author (2022).

the PAs (managers, monitors), and the public schools (principals, pedagogical coordinators, teachers, and students) in its surroundings.

For implementing the GCCT, the university facilitates the dialogue between trained monitors and protected area monitors for the development of the activities in schools. The PAs are committed to contacting the schools in their surroundings in order to make the Trail's activities feasible. From the schools, it is expected, after the training provided by Ecossistemas Costeiros, the involvement of their students in the study activities before and after the visit. We detail this process in the following flow chart (Figure 2).

Figure 2: Flowchart represents the stages of planning, preparation, application, and follow-up of the activity.



Source: Elaborated by the author (2022)

Currently, the Ecossistemas Costeiros Project operates in a network with four State Parks that are protected areas in the State of São Paulo in southeastern Brazil. The state parks are: the Anchieta Island State Park, the Mosaic of Conservation Units Juréia Itatins (MUCJI), the Jaraguá State Park (PEJ), and the USP Science and Technology Park (CienTec-USP). In 2017, the Project served 1,984 students, 128 teachers in 35 public schools. In

2018, 2,315 students from around these PAs, and over 150 teachers from 11 schools trained on the topic, took part in the GCCT. The following year, 2019, 1388 students attended and 109 teachers trained in 28 schools. About the training with teachers, it is noteworthy that teachers from different subject backgrounds participated, such as Portuguese, physical education, geography, history, art, philosophy, biology, chemistry, and physics.

The Global Climate Change Trail

GCCT is an educational model developed to support public education, aimed at primary and secondary schools, ages 11 to 17, as an outdoor education activity. They structure the model in the format of a protocol, a central model trained monitors registered with the project can apply, which complements the teaching offered in classrooms by teachers.

The monitors are usually undergraduates, postgraduates, and employees of the PAs trained by the University of São Paulo during a training course, where they address concepts of climate change and its effects on global health, biodiversity, and cities, and provide reflections on critical and emancipatory environmental education. The teachers approach the theme before addressing the subject with their students in the classroom through the training, in an open meeting format where all participants are invited to share their academic knowledge (Figure 3).

After this process, the teachers promote a discussion with their students before the field visit to one of the network's conservation units, where the GCCT model protocol is applied during a collaborative activity along a nature trail. Students should walk the GCCT in groups of five, using the material provided by the University, and accompanied by an accredited monitor able to work with the protocol (Figure 4). They present the interdisciplinary content in stations along the path in specific approaches, typically playful, each of which lasts approximately an hour

Understanding of concepts that appear in the national curriculum increased, such as the Industrial Revolution, the carbon cycle, the com-

Figure 3-4: Training with teachers from Peruíbe/SP at Itinguçu State Park (Arpoador Nucleus), at MUCJI (left); Students performing the Global Climate Change Trail activity at Itinguçu State Park (Arpoador Nucleus), at MUCJI (right).

Source: authors' private archive (2022)

position of atmospheric gasses, and the role of protected natural areas. In a broad view, it provides a more integrative and critical understanding of the natural environment, influencing values and attitudes that allow participation in the search for understanding to minimize socio-environmental problems.

It is important to highlight strategic aspects for those who seek to develop a similar activity. In this sense, we seek in these last words a short synthesis regarding the challenges and possibilities involved in our experience with the learning model presented.

Working with the public research, educational, and environmental systems in a country with growing social inequality, produced by the ultra-liberal developmental model, is a broad challenge. The weakening of these institutions in favor of the growth of the private sector implies directly in the reduction of their capacity to manage and face the daily situations for which they were designated. The insufficient hiring of people, both in schools and in protected areas, overburdens those who are there, postponing the fulfillment of supposedly simple tasks, such as scheduling a visit by the training team to the school.

It is not enough to argue about the complexity of the issues and the lack of specialized training without considering, in a critical and systemic way, aspects that include the devaluation of teaching careers in basic education and environmental management. In our experience, we found teachers who work in more than one institution, some up to three, in order to complement their income. Similarly, in the Protected Areas, the people assigned to the opening and maintenance of the trails end up being the same who are involved in the training programs and public use of these spaces, overloading them with the accumulation of duties. In the same direction are the actions of the team at the university, which also takes on the responsibility of raising funds for projects, even though university extension is the culminating activity of the public higher education institutions in the country, which often use their own resources for necessary travel.

This scenario creates a litany of challenges. There is difficulty in scheduling training activities from the university, both in schools and in the Protected Areas (PA); in establishing continuity of the activities proposed in tutoring, creating barriers to the full accomplishment of the GCCT in the PAs; and financial obstacles to the viability of the transportation of both the students to the Protected Areas and of the training team to the PAs and schools, which is dependent on the project's funding and not guaranteed by the public state apparatus.

Looking at it from a different perspective, in terms of possibilities, we emphasize the excitement surrounding the opportunity for ongoing education for professionals engaged in both schools and Protected Areas. This includes fostering the engagement and awareness of students and teachers regarding environmental themes. There's also the potential to integrate theory and practice through an educational approach on climate change, reinforcing the importance of natural public spaces as carbon sinks. Additionally, the university plays a crucial role in coordinating basic education with Protected Areas, aligning with the specific federal law's provision to 'favor conditions and promote envi-

ronmental education and interpretation, recreation in contact with nature, and ecological tourism "(Brasil, 2000). Finally, the union between the university, Protected Areas, and basic education is highlighted as a laboratory in the territory, creating unique possibilities for the development of research activities in the integrated teaching of environmental themes and in the evaluation of the perceptions of the various social agents involved in these activities.

CHAPTER FIVE

From Waste to Sustainability:

Dialogues from Citizen Science, Sustainable School Nutrition, and Their Contributions to Planetary Health

AUTHORS
Jussara Almeida Bezerra
and Dr. Natalia Pirani
Ghilardi-Lopes

My name is Jussara Almeida Bezerra. I am a school principal in the São Bernardo do Campo Municipal Network in São Paulo. I have previously worked as a kindergarten and elementary school teacher in the SBC and Diadema school systems. I teach in higher education in extension, improvement, and post-graduation courses on subjects related to early childhood education, literacy, and active learning methodologies. I am a Master's student in the program for the Teaching and History of Science and Mathematics at the Federal University of ABC (UFABC), in the specialty of Teaching and Learning of Science, researching the interfaces of citizen science and education and in the research group on citizen science and Participatory Environmental Conservation, supervised by Professor Dr. Natália Pirani Ghilardi-Lopes.

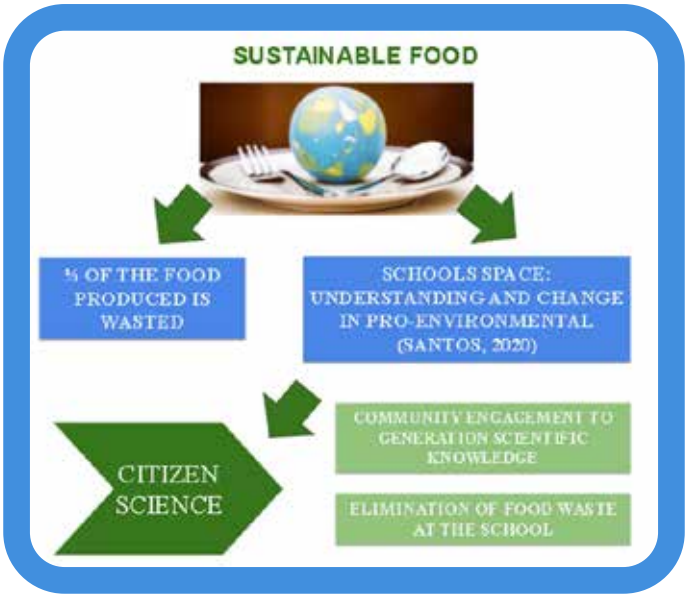
I am Natalia Pirani Ghilardi-Lopes. I received both my bachelor and graduate degrees in biological sciences at the University of São Paulo (USP). Additionally, I have a doctorate in Ecology of Benthic Communities of Consolidated Substrate from the postgraduate program in botany at USP. I was an environmental specialist at the Secretaria do Verde e Meio Ambiente of the Municipality of São Paulo. Since 2010, I have been a professor at the Federal University of ABC.

I teach, research, and perform extension studies in marine and coastal environmental education and in citizen science for environmental conservation, having published several articles and books within these themes. I provide guidance in the master's and doctoral programs in the "Evolution and Diversity" and "Teaching and History of Science and Mathematics" courses, both offered by UFABC. I am a member and co-founder of the Brazilian Network of Citizen Science (RBCC).

Wasting food causes several impacts to the environment and the world economy. Food waste can be complex to solve since it requires

changes in the way we value and consume food, which is influenced by various factors, including cultural, social, and psychological, which do not always follow economic or ecological rationality (Ipea, 2009; Triches, 2015). Conscious consumption, which presupposes minimizing waste, can contribute to environmental conservation from the perspective of sustainability (Akatu, 2018). In this sense, the school plays an important role in understanding waste and developing pro-environmental behaviors (Estima et al., 2009). However, wasteful behavior also occurs in schools, particularly when observing students' eating habits during school feeding times (Torrent et al., 2018). The school must act to promote integral human development, including not only the acquisition of knowledge and skills but also complex levels of thinking and commitment through attitudes and values (Brasil, 1996; Berbel, 2011). Thus, it is necessary to think of schools as spaces to develop pedagogical actions that enable full human development and allow students to become agents of change in society and the environment. In the year 2019, I participated in a university extension course called "Participatory Environmental Conservation in Schools", coordinated by Professor Dr. Natália Pirani Ghilardi-Lopes. It opened up the world of citizen science to me. The course showed me the protocols for applying didactic sequences with scientific themes in schools and instilled the belief that citizens can build scientific knowledge in partnership with academic initiatives from observation, data collection, and analysis. The course brought an intervention proposal for the development and application of citizen science protocols involving some scientific theme:

Figure 1: Sustainable School Diet and its interfaces with citizen science



Source: The authors.

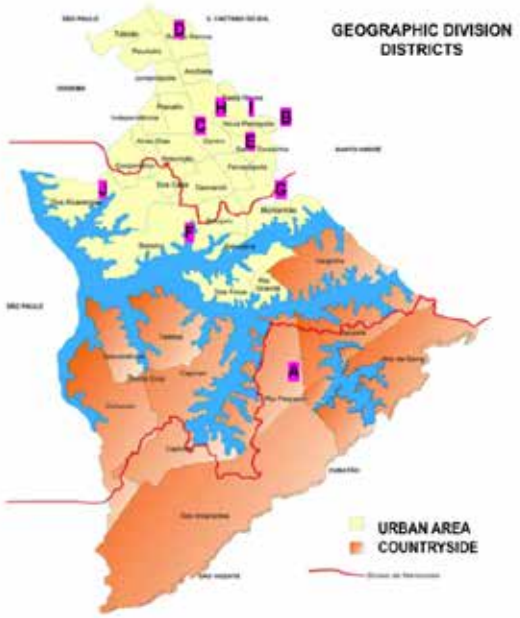
The school where I worked was going through changes in its menu; I noticed a lot of food waste in the meal routine of the students in the early elementary grades. As the manager of this unit, I tried to make educators and students aware of the importance of avoiding waste, using my knowledge as evidence and adding in some of the common sense phrases mentioned above. These speech contents showed weaknesses and ratified the importance of thinking about consistent pedagogical work that is systematic and capable of producing changes with scientific basis. Food waste considering sustainable food education was a hidden theme in the Brazilian school curriculum.

The research is currently in the field research phase. They will collect data in ten schools in the early years of elementary education in the municipal education system of São Bernardo do Campo, São Paulo, Brazil. They selected the schools based on the principle of sampling space variability, in order to get data from different contexts of the city for multiple case studies, represented by macro-regions (Figure 2).

Given the scenario of identifying food waste at school, I connected this to their daily social practices. After I considered possibilities of knowledge gained in the extension course and the intervention task, I devel-

Figure 2: Map of the municipality of São Bernardo do Campo, with the location of the schools chosen for field research, representing the variability of the sample space.

	SCHOOLS	DISTRICTS
A	EMEB Prof° Suzete Aparecida de Campos	Riacho Grande
B	EMEB Padre Ângelo Ceroni	Nova Petrópolis
C	EMEB Julio de Grammont	Planalto
D	EMEB Paulo Teixeira de Camargo	Suíço
E	EMEB Prefeito Aldino Pinotti	Vila Santa Terezinha
F	EMEB Deputado Odemir Furlan	Batistini
G	EMEB Prof° André Ferreira	Ferrazópolis
H	EMEB Prof° Cassiano Faria	Centro
I	EMEB Prof° Marineida Meneghelli de Lucca	Vila São Pedro
J	EMEB Prof° Karolina Zofia Lewandowska	Alvarenga



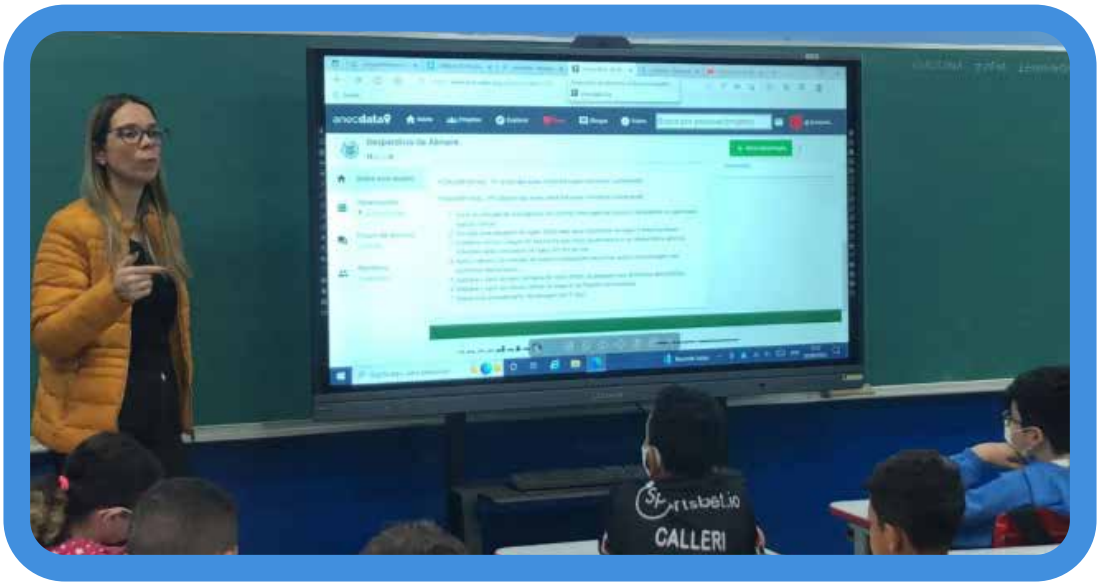
Source: http://www.omelhordobairro.com/saobernardocampo-planalto/historia. Accessed on Feb. 05, 2023.

oped a citizen-science protocol. This comprised a didactic sequence in which students would actively face the problem of food waste, raising hypotheses, then collecting and analyzing data that would lead them to scientifically based changes in attitude. I hypothesized that citizen science could be an important tool for building this knowledge. For effective behavioral changes to occur, we must provide students with learning situations in which they are active in the construction of knowledge. This enables them to produce meaning and attach relevance to the objects of knowledge from the development of hypotheses and investigations about the impacts of eliminating wasteful eating behavior on the environment and economy (Moser, 1998; Pelizzari, *et al.*, 2001).

Initially, a pilot test was conducted, which contributed to the adjustments and validation of a school-based citizen science protocol. Applied throughout different grades and in schools with differing demographics, this pilot was part of my master's degree work in the program for Teach-

ing and History of Science and Mathematics from the Federal University of ABC, overseen by Professor Dr. Natália Pirani Ghilardi-Lopes. The pilot highlighted the need to publish the citizen science data produced and found on online platforms, following one principle of citizen science as part of the Open Science movement (Robinson *et al.*, 2018). The platform adopted to host the data was *Anecdata*.

Figure 3: Students using different platforms to share citizen science.



Source: The authors.

We divided the didactic sequence into steps. First, we started by weighing and recording the amount of food discarded at the school over five days. Two students performed the weighing to get the initial data. We chose not to reveal what this data would later describe to avoid influencing behavior. Next, we conducted a questionnaire to understand the initial perception about the subject. Afterwards, students engaged in classes covering food waste and its environmental impacts; the culture of consumerism; production chains and waste; the United Nations Sustainable Development Goals; and how to fight hunger and food waste. Students completed calculations using the data collected to verify how much water we can save by reducing or outright eliminating food waste. With this context, the class began weighing food waste for another five

days. At the conclusion of activities, students filled out a final questionnaire to verify learning and identify behavioral changes based on the knowledge built. Finally, the students published their collected data on the Anecdata Platform.

During the theory classes, the first ideas taught to students were that science is for everyone and everyone can be a scientist-citizen. The importance of science in everyday life was addressed, specifically, that it is possible to eliminate food waste through scientific knowledge. They permeated discussions with newly gained knowledge, among them, the various processes by which we produce food in addition to a focus on water and its role in the production, distribution and preparation of food (Figure 08). students could understand that, by wasting food, they would also waste a natural resource fundamental to maintaining planetary health: water.

Data from the questionnaires and the weighing activities in this study aim to verify conceptual and procedural learning. The data analysis will be quantitative (analysis of food weighing and closed answers in the questionnaires) and qualitative (content analysis of the students' statements expressed in the interviews and answers to open-ended questions in the questionnaires) (Bardin, 2011).

Open-ended questions address students' level of agreement with statements about wasted food in different contexts, such as considering food waste in their local community and in their school. The research project is ongoing, and it is already possible to see evidence of learning and behavioral changes in citizen science (Phillips et al., 2018). One school surveyed moved towards a near complete elimination of food waste by students who took part in this pilot activity. The weighing of food in the initial phase was 2.45 kg, but at the end of the project, this amount was near 0 kg. Notably, in the initial phase of administering the questionnaire, twenty-four students responded they felt their "school's trashcan has a lot of wasted food." Testing at the conclusion of the activity found the same number disagreed with the statement, a testament to the change in behavior of the students through relevant experiential learning.

Continuing with the qualitative approach of the data, the final questionnaires of this class showed that the students began to adopt and justify the importance of eliminating food waste, a fact not true of the same students in the initial phase. Students were asked, "What makes people waste food?" One student answered, "They don't like the food at school." After gaining knowledge through the experiments, when asked again during the post test, he answered, "They don't take care of the environment and water," perceiving elements of the contents worked throughout the didactic sequence, grounding the thought with specific argumentation based in scientific content.

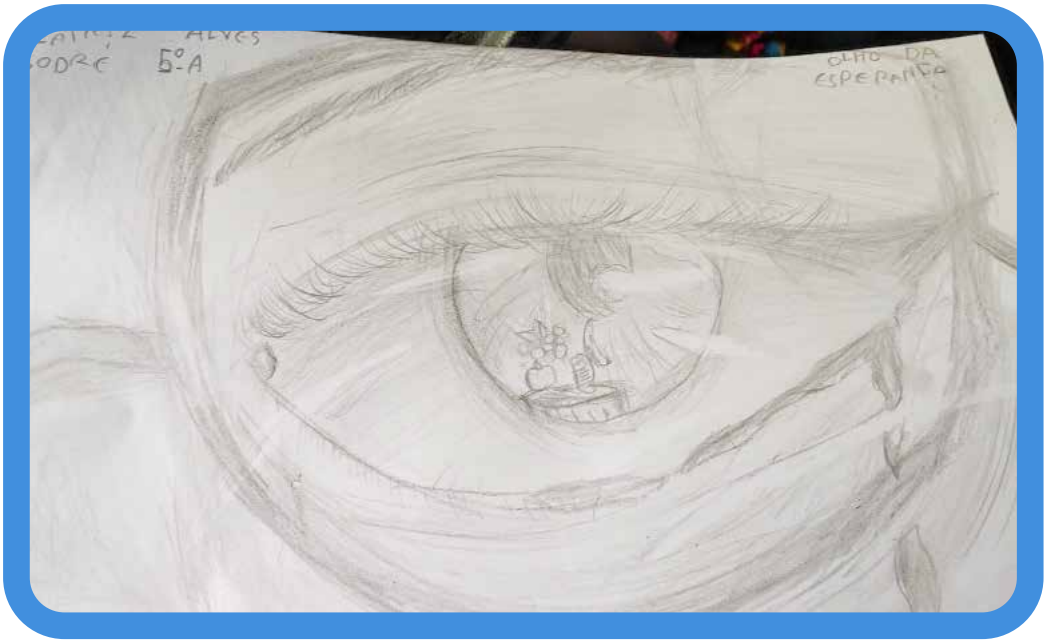
In this sense, the didactic sequence based on the assumptions of citizen science has proven favorable to the consolidation of students' learning by allowing the active construction of pro-environmental behaviors with a scientific basis (Bonney *et al*., 2009). In addition, the activity brought about the reduction of food waste in schools. As an adjunct action of the work, from May to July 2022, I taught a university extension course by the Pró-reitoria de Extensão e Cultura of the Federal University of ABC. The target audience of this course was teachers from different school networks throughout São Paulo. We wanted our main points to empower these educators to understand the characteristics of forming knowledge and practices around students' eating behaviors; consider the school space as a place of potential for the formation of nutritional and sustainable eating habits; and eliminate food waste in the school space by building knowledge based on the principles of sustainability and citizen science. This edition of the course had sixty-one participants.

Attendees pointed out the relevance of the theme for schools and in teaching practice and its ample possibilities of practical application, considering the diagnosis of food waste in the various school environments represented in the training. They could develop a diagnostic observation task of food waste in their schools, along with interventions to address it, and were encouraged to develop the citizen science protocol in their grades and subjects. To incorporate didactic support into the classes, I

organized slides with information and videos that approached the themes described. An avatar, Juju, talked to the students, appealing to the fun-loving sense characteristic of the age group.

Working with the themes of food waste and citizen science gives us a glimpse into potential future achievements in this field. Using student experiential learning as an effective way of preserving planetary health provides a fresh solution to the problem of food waste. All major transformations are first made through small, manageable changes in our daily lives. In this context, each one, teacher and student alike, has an important role as an agent of behavior change (Figure 4). The present proposal dialogues, in this sense, with the following idea: "Is it better to have too much than too little? No! It is better to consume what is necessary and not to waste it."

Figure 4: Drawing produced by a student from the schools researched, entitled "Eye of Hope", during the development of the lecture classes



Source: The authors.

CHAPTER SIX

Diversity, Sustainability, and Innovation:

19th Edition of the Agro-Family Midwest Fair (Feira Agro Centro-Oeste Familiar – ACOF)

AUTHORS
Ana Luiza Araújo and Beth Alamino

The natural environment makes the development of life on our planet possible. However, waste, misuse, and carelessness towards natural resources impact people's quality of life and generate a multitude of environmental problems. Increasingly, it is necessary to think about our present and the next generation's future. It can take several social and sustainable actions to make people more sensitive to this issue.

Sustentarea UFG is a project in partnership with Sustentarea USP, the aim of which is informing the populace of and discussing sustainable food using scientific evidence as a conduit to promote changes in habits. Sustentarea wants to improve the quality of life and health of both the population and the planet. The project interprets and propagates discussion about environmental sustainability through food.

Sustentarea supports actions aimed at changing eating behavior by producing science-based materials and educational events that promote sustainability and responsible eating. One pillar of the project is freely sharing information and recipes that have lower environmental impact and use raw materials, such as fruits, vegetables, and greens that can be grown on small family farms and *plantas alimentícias não convencionais* (PANCs), or Nonconventional Edible Plants.

Since 2000, The Agro-Family Midwest Fair (ACOF) has been an annual event in Goiânia. The School of Agronomy and Food Engineering of the Federal University of Goiás (UFG) held it. Besides promoting the fair and providing the space for the event, UFG also promoted the mobilization of the exhibitors, including family farmer cooperatives and technology companies, and helped prepare the principal topics for the seminars. After five years, ACOF's focus has turned to family agriculture, acting as an opportunity to exhibit its products and providing negotiation space for public policies in the seminars.

In 2014, for the first time, ACOF was hosted by the Federal Institute Goiano, in Morrinhos, tucked in the countryside of Goiás. This provided an incentive to increase in quality and productivity while boosting the value of products generated by family farmers while also maintaining access to

information and agricultural technologies. 2015 saw the authoring of a letter to the society of the Agro-Family Midwest Fair which showed the various progress obstacles to government agencies and civil society.

The State University of Goiás organized the 16th ACOF (UEG) in São Luís de Montes Belos from May 9th to 11th, 2018. The first edition under UEG had an innovation: the Open Fair, an attempt to achieve greater visibility and improve product sales. This edition's theme was: "Family Farming: Opportunities and Challenges in Healthy Food Production."

Figure 1: 19th edition of the Agro-Family Midwest Fair (ACOF).

Source: Authors.

Sustentarea UFG is supported by high school, undergraduate, and graduate students, in addition to professionals from various fields of knowledge around the country. In 2022, we counted on the coordination of UFG professor, Dr. Raquel Santiago, the mentoring group and the project members. At ACOF 2022, we had two mentors as representatives:

Ana Luiza Araújo, who is a Master Nutritionist in Food Science and Technology, and project member Beth Alamino, an aromatherapist and nutrition scholar from UFG.

The 19th edition of the Agro-Family Midwest Fair took place from May 19-21, 2022, at the IF Goiano Ceres Campus, which is in Goiás. Originally scheduled for 2020, this event was postponed because of the Covid-19 pandemic. The goal of this fair was to privilege local farmers, displaying their work and providing the opportunity for participants to discuss and clarify their questions.

Figure 2: *Sustentarea UFG* exhibition booth at ACOF 2022

Source: Authors.

The event's theme was "Diversity, Sustainability, and Innovation". The program included a fair that included family agriculture products, handicrafts, and a food court. There were also lectures, mini-courses, workshops, and artistic activities available for the public. All activities were open to the public and free. The event was organized in partnership with institutions such as the Federal University of Goiás.

During the three days of the fair, discussion panels provided critical reflections on the development of the works. Lectures broadened the proposed topics, and the information booths spread critical knowledge during the event. Several papers were submitted in the poster category, where other participants in attendance could discuss and evaluate them.

The public got to know *Sustentarea UFG* at the exhibition booth through the experience and expertise of the attending team, who replicated knowledge about food and sustainability. The recipe books, Quilombola Cuisine and Sustainable Food in Regional Cuisine, were presented as well as leaflets with fruits from the Brazilian Savannah. During the event, there was an experience exchange amongst participating projects, and we clarified questions about our project with fellow participants. Sustentarea's participation at ACOF 2022 represented the academic community's efforts to make important topics, such as sustainability, more accessible.

For all those who wish to create educational actions in planetary health, it is important to remember that we must ground our acts in scientific evidence. Our mission is to make these studies accessible to the public, hoping the academy can be an extension to the community.

CHAPTER SEVEN

The Itinerant Career Space of the Federal University of Goiás

(Espaço Itinerante das Profissões da UFG)

AUTHORS
Ana Luiza, Donovan Humphrey Franco, Emanuel Ramalho, Gabriela Bosero, and Dr. Raquel Santiago

The Federal University of Goiás proposed the establishment of this initiative through the representatives of the Dean of Extension, responsible for overseeing the institution's extension projects. A dedicated local team, led by their professor, Dr. Raquel Santiago, actively participated in the event. The entire team collaborated in crafting activities and devising promotional strategies, all of which were showcased during the event.

The primary goal of this activity was to share and promote the work developed by *Sustentarea UFG* to society outside of the university. The team's exhibition booth displayed knowledge of the traditional fruits of the Brazilian cerrado, or the Brazilian Savannah. This presentation celebrated sociobiodiversity by acquainting attendees with plantas alimentícias não convencionais (PANCs), or Nonconventional Edible Plants, which are hugely present in Goiás. Visitors could access local fruits' diversity and learn the importance of valuing them in addition to getting information about popular PANCs in the region, with an emphasis on the necessity of incorporating these widely available food sources into our regular diet. With a light, playful tone, we presented this information accessibly to various audiences while improving the visibility and scope of current and impending events and actions as developed by Sustentarea UFG.

Activities performed during the action.

Source: Authors.

The group used resources such as slides and interactive videos to provide references during discussions along with a catalog with information about PANCs, savannah fruits, and sociobiodiversity. We encouraged visitors to interact in the exhibition by participating in a quiz game to prove their understanding of the utility of PANCs in their diet.

As a final message to those who wish to conduct educational actions in planetary health, please remember that accessibility when sharing knowledge is essential, as this makes education democratic. In its fundamental triad of teaching, research, and extension, the academy needs to be prepared for the dialogue with the community, in order to make them allies in the planning and elaboration of activities that will benefit the collective.

CHAPTER EIGHT

Vegetable Gardens in Schools Project

(Projeto Horta nas Escolas)

AUTHORS
Donovan Humphrey Franco, Emanuel Ramalho, Lorena Lourencetti, and Dr. Raquel Santiago

Due to demand from The Municipality of Goiana, this project developed a plan for installing vegetable gardens at select public schools in the area. A proposal from their city hall aligned the group values of *Sustentarea*, a university extension center that intends to discuss healthy and sustainable nutrition, providing further motivation for us to expand the project.

Aiming to improve meal nutritional quality, reducing food expenses, and food waste, the project goals included promoting the use of all food parts and nonconventional edible plants in people's daily routine, which stimulated the consumption of fresh food and nature contact. The project served as an important tool to implement environmental education by teaching in a didactic way and using practical classes about the cultivation of organic food with short production cycles that do not require large spaces for growth and harvesting.

Employees of the Goiânia municipal school systems

Source: Authors (2022).

Finally, as a message to everyone who is interested in contributing to educational action in planetary health, we advise you to understand the reality of your audience. Engage with every person in the community where this audience exists; education is not solely limited to the young people learning, but their families and other residents of the local area. Invite teachers and other school staff members, such as instructional

coaches, counselors, principals, and those responsible for school meal preparation, into conversations about learning opportunities and lesson content. Use organic opportunities to show how each of our actions improves planetary health both locally and globally. As Albert Einstein once said, “Learning is an experience. Everything else is just information.””

CHAPTER NINE

Planetary Health in Amazônia, Brazil: Creating Teaching Material for Riverside Schools Educators

AUTHOR
Paula Regina Humbelino de Melo

My name is Paula Regina Humbelino de Melo. I am a graduate of biology and chemistry from the Amazonas Federal University (UFAM)'s Institute of Education, Agriculture and Environment (IEAA) which is also where I earned my master's degree in Teaching of Sciences and Humanities. I am a researcher for the Lab of Ichthyology and Fishing Regulations of Vale do Rio Madeira and a professor at UFAM, which is in Humaitá, Amazonas, Brazil. Currently, I am pursuing a doctorate in the post-graduate program, Education in Sciences, which is offered by the Federal University of Rio Grande do Sul in Porto Alegre, Rio Grande do Sul, Brazil.

During my doctoral coursework in 2022, I created educational material entitled, "Planetary Health in Amazônia: Education, Health and Environmental Sustainability" as an Ambassador of Planetary Health, an opportunity created by the Planetary Health Brazil Study Group. This organization is linked to the Institute of Advanced Studies at São Paulo University.

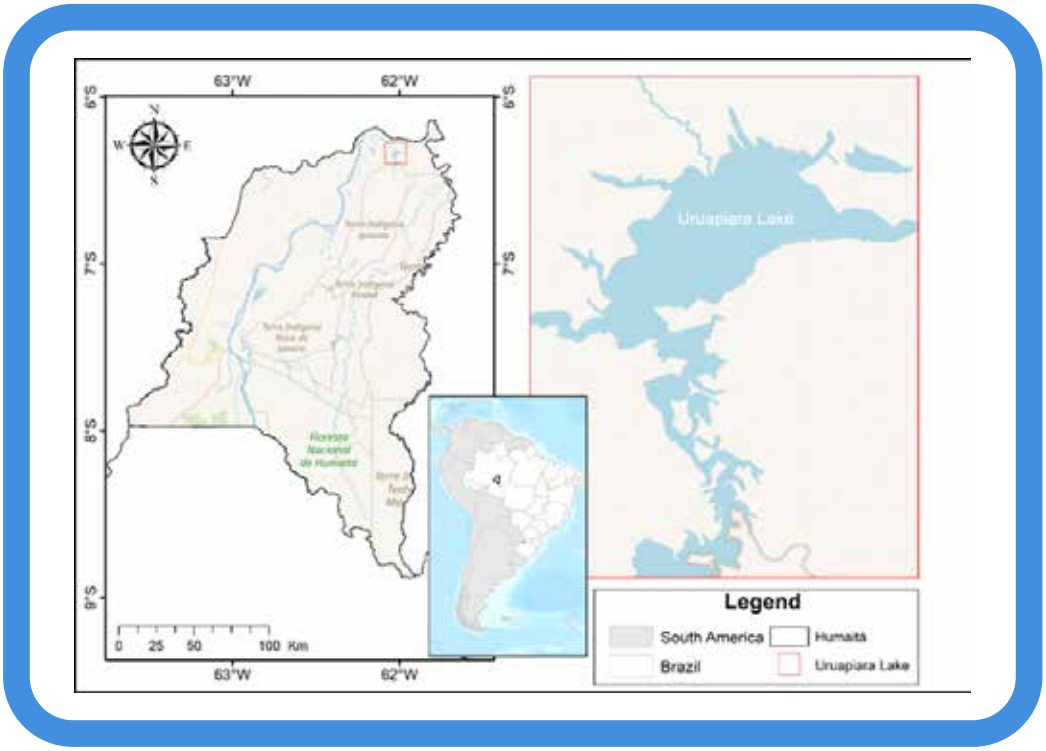
The triad of education, health, and environment enables discussion on several questions that permeate the Anthropocene Epoch, highlighting the importance of the realization of our interconnection with nature and need to disseminate planetary health knowledge, starting with the voices that represent the future, children and teenagers at all levels of education. Promoting this movement in Brazil, one of the most biodiverse countries in the world, would give students an immense advantage in gaining contextual knowledge.

The preparation of this material considered the needs and status of the Brazilian Amazon, specifically the states of Amazonas. The centrality of this biome in a global context, particularly its role in the carbon cycle, biodiversity, hydrology, and climate stability, made it an ideal setting for this work. Besides emphasizing the importance of this region on a national and worldwide level, this proposal also brings focus to anthropic transformations made to the Amazon biome and its negative effects on the planet's health.

Experiences with field education teachers informed the teaching material in a riverside school, near Lake Uruapiara, which is in Humaitá,

a city in the southern region of Amazonas (Figure 1). This material contains didactic and reflexive orientations for educators with the goal of inspiring them to teach planetary health concepts effectively. The twofold aims of the program were: i) searching for practical and adaptive solutions to socio-environmental questions that have intensified because of anthropogenic actions and compromise both human health and that of the environment we live in; and ii) inspiring and empowering young people to become leaders in the urgent cause of preserving and enriching the only habitable planet we have.

Figure 1: Lake of Uruapiara, AM, Brazil



Source: Paula de Melo (2022)

Based on the articles, "Cross-cutting Principles for Planetary Health Education" (Stone *et al.*, 2018) and "A Framework to Guide Planetary Health Education" (Guzmán *et al.*, 2021), the educational material provides guided approaches to organizing lesson materials throughout grade levels. Schools are privileged spaces for discussions about themes regarding planetary health as they contribute to the spread of information about grave socio-environmental problems and identify proper strategies for

altering behaviors and building fair dialogues that serve as starting points for actions that solve environmental problems threatening our existence.

Because of the particular characteristics of students in these field schools that have the Amazon Rainforest as their field station, it is essential to embed an appreciation for this space in the school teachings of riverside students. Valuing their knowledge, view of the world, and unique ways of relating to nature, expounding on students' prior knowledge in their science school work would provide powerful foundational subject context respective to the area's cultural heterogeneity, rich natural resources, and biodiversity. In this direction, the integration between the students' prior knowledge and scientific education can take place with more tranquility and potential.

For its richness and exuberance, the Amazon Rainforest is one of the most sought after places by the world's major economic powers; however, the desire to explore what exists in the Amazon and what they have not yet discovered has been threatening this environment in profound and sometimes irreversible ways. One example of those impacts in the Amazon is deforestation, which opens extensive clearings amidst dense forest. According to 2021 data from the Instituto do Homem e Meio Ambiente da Amazônia (IMAZON), there was all-time high deforestation in the last decade, 10,362 km2, with Amazonas being the second-most state taking part in deforestation, from 1,395 km2 of devastated area in 2020 to 2,071 km2 in 2021. As a result, this abundant living laboratory has faced catastrophes that bring negative effects to humanity, such as biodiversity emissions, extreme temperatures, changes in ecosystems, losses of traditional knowledge, and threats to environmental and human health.

Riverside schools in Amazonas have specific characteristics, which makes it essential to prioritize the settings where these institutions exist. Educators there face numerous challenges, such as lack of materials, financial resources, infrastructure and initial or continuing education; great distances; accumulation of job functions; and discrepancies between students' ages and grades. However, these rich and unique places, when well

used, can enhance the teaching and learning processes, particularly of planetary health. As a starting point for the educational material, we created the infographic featured in Figure 2 with the purpose of reflecting on the Amazon that we want and the consequences of socio-environmental disasters caused by human action. The positive interactions presented show the value, vivacity, and biodiversity of the region, consequently affecting the health of the Amazonian ecosystems and their populations. There are negative interactions, with elements that represent socio-environmental disasters and their consequences in the Amazon.

Figure 2: Infographic showing the problems and threats to the community's sustainability above and possible solutions below.

Source: Author

Planetary Health Educational Action in Amazônia, Brazil

The educational material developed brings a didactic transposition, making scientific and academic knowledge more palatable, accessible, and

useful to educators from rural schools in Amazônia. We structured it prioritizing the Five Domains for Planetary Health Education, as proposed by the Planetary Health Alliance (PHA): a) Interconnection within Nature; b) The Anthropocene and Health; c) Systems Thinking and Complexity; d) Equity and Social Justice, and e) Movement Building and Systems Change (Guzmán *et al.*, 2021). An additional foundation resource used was the Cross-Cutting Principles for Planetary Health Education (Stone *et al.*, 2018). The intention is that the document can be inserted in classes of different disciplines, bearing in mind the need for actions with riverside children and adolescents, sensitizing them to be critical and responsible citizens at local and global levels and multipliers of attitudes and practices sustainable for the health of the planet.

The resource was divided into nine chapters. We emphasize that in all sections it was possible to build a didactic sequence with suggestions for texts, films, videos, podcasts, theoretical-practical activities, interviews, questionnaires, physical activities, poems, and other resources. In addition, investigative case studies were created, entitled "Somewhere in the Amazon...". These topics tell stories of residents of riverside communities (ribeirinhos, in Portuguese), emphasizing issues involving planetary health.

I: Planetary Health Education

This first chapter briefly presents a conceptualization of planetary health, considering that it is a growing area and that needs to be understood by education professionals as a transdisciplinary area. The document references "The São Paulo Declaration on Planetary Health" (Myers *et al.*, 2021), which addresses the need for schools to include planetary issues in their curricula, practices, and actions, so students can discuss and accordingly position themselves concerning the future of the planet. Remaining text brings notes about Amazônia's specificities, considering the teaching strategies of planetary health in this region need to be present and meet certain particular circumstances guided by the centrality of the Amazon Rainforest.

II: Learning Concepts for Planetary Health Education

In order to deepen studies in planetary health, an approach of key concepts in the material was chosen. Understanding these makes it possible to dialogue with the students' knowledge as this population uniquely presents rich and diversified traditional knowledge of their regional culture, providing the construction of pillars for an improved scientific education and for the strengthening of their experiential knowledge, and adding meaning, joy, and relevance to their learning.

III: "Our Planet, Our Home"

The aim of this chapter addresses how anthropogenic actions have affected the planet and humans need to shift their mindset to consider Earth "our home", since we depend on the natural resources available on it. That blue planet featured in books and online is compromised. We live in a time so strongly marked by anthropic actions on the globe that several scientists have been differentiating it with specific nomenclature: Anthropocene. Thus, the proposed reflection is in the sense that we have no alternative other than the urgency to act in favor of planetary balance.

IV: Climate change in Amazônia

This chapter briefly presents climate change in Amazônia. This, locally and globally, is home to the greatest biodiversity in the world and responsible for the rainfall regime in Brazil and Latin America. The text addresses deforestation and its effects on climate change, with discussions on the greenhouse effect, global warming, extreme weather events, human health, and the effects on the most vulnerable populations. It is a chapter featuring questions about planetary health and its implications for our own survival, which proposes changes in habits for the viability of human life in present and in future times.

V: Air Pollution in Amazônia

In the chapter regarding air pollution, reflections highlight anthropic actions that have contributed to strongly intensifying the rate of pollutant particulate, implying damage to respiratory and cardiovascular health and even premature deaths. These issues are important to be supported by didactic material, because some lessons present them from a perspective that seems disconnected from real life. Needing to be linked to the context in which they take place is essential for these lessons to make sense to students and their realities.

VI: Food and Planetary Health in Amazônia

Among the themes of planetary health, food is one that needs to be addressed to a greater degree in educational institutions. Doing so in Amazônia, a location home to a host of unique native species and traditional cultures, would be of immense impact. It is very frequent for these institutions to offer ultra-processed foods in school lunches. This led us to question: How does an environment in the largest tropical forest on the planet offer its students low-nutrient foods full of preservatives and artificial flavorings? It is in this sense that this chapter refers to the importance of valuing family farming, especially in riverside contexts. Schools are spaces that need to include healthy and sustainable food in their lunch offer, to value local culture. They can promote healthy actions, such as the creation of vegetable gardens at school or in the community, and lend their expertise to debates on sovereignty and food security.

VII: Water and Planetary Health in the Amazon Context

The aim of this chapter is to address the waters of the Amazon River as a vital actor for the environmental health for all living beings, especially the riverside inhabitants. Two common issues affecting Amazonian riverside communities are the absence or inadequacy of basic sanitation,

and heavy metal contamination by illegal mining. These issues result in health problems, for example, waterborne diseases. The proposals stated in this chapter are directed towards the principal causes and consequences of water pollution for planetary health.

VIII: Biodiversity Versus Loss of Biodiversity in Amazônia

Amazônia's biodiversity has great representation at a global level because of the diversity of the species that live there, as it plays a fundamental role in the maintenance of ecosystems and the existence of life. In this sense, the chapter aims to point out the main environmental factors that threaten Amazonian biodiversity and subsequent impacts on humanity. It is fundamental that scientific research studies the effects of biodiversity loss on human health, considering that species threatened by environmental degradation migrate to other regions, which may cause ecological imbalances and proliferate diseases among species, including humans. Therefore, the proposed educational activities have a goal to encourage and inspire the preservation of forests, avoiding damage to biodiversity, and, above all, allowing students to reflect on the need to care for the environment and fight for environmental conservation.

IX: Planetary Health: Gender Equality and Women Empowerment in Amazônia

Women have been making advances in Brazilian society, such as studying, working, voting, and having political and leadership roles. However, this progress does not prevent the existence of gender inequality in several sectors. In this context, the material explains planetary health with a vision of empowerment for women and girls, considering the global need to achieve the fifth Sustainable Development Goal (SDG) of "[achieving gender equality and [empowering] all women and girls" (UN, 2015).

This SDG states that the female gender has an indisputable role in mitigation and adaptation to issues involving planetary health. Considering that women have different roles in the field, are directly involved in agricultural activities, carry out their activities at home, and are holders of traditional knowledge, it is fundamental to inform these guardians of their rights, their role, and to address the main challenges they face as citizens in an unequal society. As a result, the proposed educational activities aim to empower women, reflecting about their realities and future prospects.

Final Remarks

Teaching planetary health in schools is a challenging, yet rewarding way to sensitize children and young students to act as subjects capable of intervening in changes and adaptations to the environmental catastrophes that have been making the planet sick. It should be noted that our role as educators is not only to warn about the problems and consequences of what we have been causing to planetary health, but also to think that we ourselves will be the most affected or the most benefited by our present and future actions.

Thus, we believe that there is still hope for a sustainable future in which everyone understands our lives are interconnected with nature and that we need to act while there is still time. Join us, tread your path in favor of planetary health, and be part of this urgent cause. Allow yourself to take action that contributes to a sustainable future!

Acknowledgments

Federal University of Rio Grande do Sul (UFRGS), Federal University of Amazonas (UFAM), Amazonas State Foundation for Research Support (FAPEAM), Development, Economy, Science, Technology and Innovation Secretariat (SEDECTI) and Planetary Health Ambassador Program 2022.

CHAPTER TEN

Planet&Ar Project

AUTHOR
Nelzair Vianna

Planet&Ar is an initiative that believes in advances based in care for the environment from the approach of planetary health. The scope includes the measurement of air pollution in areas of environmental and social vulnerability, and ciência cidadã, a Portuguese phrase that translates to “education and citizen science”, which considers actions in risk perception on climate change and air quality. This project is part of field research led by the proposal to evaluate exposure impact on the health of populations in the communities of Ilha de Maré, or Maré Island, and Subúrbio Ferroviário in Salvador, Bahia, Brazil. This work takes place under the supervision of Dr. Nelzair Vianna, who has researched and developed local surveillance strategies since 2006. The project began in March 2020 as part of the public notice, being approved through the Oswaldo Cruz Foundation’s *Inova Fiocruz* program. Field activities began in 2021 following the easing of post-pandemic restrictions.

I am Cássia Flávia Moreira Souza. I’m thirty-two years old and was born in Salvador. Although many people don’t value the air they breathe, living close to nature has always been one thing that I enjoyed most. I love nature in all its manifestations and have always been concerned with keeping the environment clean. I hold a degree in biomedicine from University Maurício de Nassau in addition to a postgraduate degree in cellular and molecular biology from College Venda Nova do Imigrante (FAVENI). Currently, I’m finishing another graduate course in biology at FAVENI, maintaining my lifelong connection to and regard for the environment. Today, as a woman activist, I have been raising awareness through Planet&Ar, a project through which I have earned a scholarship. In this project, I took part in biomonitoring using a species called *Tillandsia usneoides*, commonly known as Spanish moss, which monitors air quality. Ilha de Maré, an island in Salvador, and the Metropolitan Region of Salvador received this biomonitoring for four months. Afterwards, the plants were removed and brought to the Pontifical Catholic University of Rio de Janeiro for analysis.

I am Gabriela Paes, a current medical student at the Faculty of Medicine of Bahia at the Federal University of Bahia. I am a scientific initiation scholarship holder at the Gonçalo Moniz Institute of FIOCRUZ - Bahia. My focus is to study planetary health and how it affects the health and disease process of individuals who are both directly and indirectly affected by environmental issues. I took part in a visit to Ilha de Maré with other medical students to collect questionnaires from the local population, aiming to use the data to shape practical and global health education. I believe that acting locally while thinking in a global context is important, thus; I am proud of the steps forward we are taking with this project.

My name is Iane Kathleen. I am seventeen years old and attending my first year of high school at Colégio Estadual Professor Carlos Barros, in Salvador, Bahia. During the COVID-19 quarantine, I had more time to dedicate to topics that I am particularly interested in. Through veganism, I watched many documentaries, such as *Seaspiracy: Red Sea* (2021) and read news from various sources. This gave me a better understanding of how grave the situation is, and that our eating habits can contribute to air pollution. Since then, I started to act and inform myself. This insatiable desire for knowledge and admiration for nature has always been within me. This year, the paths opened through the knowledge I gained and a mindset open to learning more yet. I still recall the affectionate look from my teachers, Quênia Lopes and Cybelle Lobão, and how much they continue to support me. I feel lucky to have their guidance. Currently, I'm taking Initiation to Theater at Center of Formation in Arts intending to qualify myself to speak in public with greater confidence. I am a participant in three projects aimed at environmental causes, namely: Planet&Ar, Salvador Climate Forum (Fórum Clima Salvador in Spanish), and United for Climate (Unidas pelo Clima).

My name is Rebeca Muniz, and I am nineteen years old. I am currently a scientific initiation student at the Planet&Ar project, supported by the Gonçalo Moniz Institute. Here, I conduct activities focused on the area of environmental sustainability, the focus of which is quantifying

the levels of pollutants present and emitted into the atmosphere. I graduated with a degree in energy engineering from the Federal Institute of Sciences and Technology of Bahia. We formed the group through the annual global Strike for the Climate. I have always been an ambitious person, from my first fall when learning to walk to my most recent college admission, making incredible achievements possible in my life. Naturally curious, my wonderings about my existence and essence occupy my daily thoughts, a driving force behind my desire to learn more about the outside world as well.

Image 1: Measuring air quality

Photo: Cassia Souza.

Clean air is necessary for all biotic elements, human beings included. The advance of industrialization, reduction of natural resources, and increase in population numbers have been associated with rising imbalances in air quality. When the air suffers from toxic agents or other residues, it affects human health, fauna, and the ecosystem. Despite the risk atmospheric pollution brings to humanity, this has not been treated

as a priority for environmental control. Considering this problem existed prior to modern industries exacerbated issues, it has been proven that industrialization, combined with nonchalance towards or ignorance of the facts, aggravates this condition (SINGH et al., 2021: LIU, et al., 2020).

According to a report by the World Health Organization, 8 million deaths occur every year because of air pollution. Of those, 4.3 million die from domestic air pollution sources. About 3 billion individuals, almost half of the current global population, need fuel with biomass to handle daily necessities such as cooking and heating. And their combustion is the primary source of toxic substances for the air (Saini et al., 2021). Fuels containing biomass are those made up of elements like charcoal, collection residues, firewood, and animal excrement, for example.

Asthma has been routinely noted as a condition that environmental issues can trigger or worse. Epidemiological research has identified several environmental risk factors as probable causes for the increasing prevalence of asthma in certain areas. Atmospheric pollution, such as tobacco smoke, mold, sulfur dioxide, nitrogen oxide, ozone, and inhaled particles, are all thought to be some of the biggest environmental contributors to asthma (Shin et al., 2022; Liu).

The community of Ilha de Maré reported events of air pollution that have plagued their communities, relating them to environmental factors and the construction of the Port of Aratu. Recognizing this demand from the local populace, Planet&Ar installed sensors to monitor the air quality in the region. The project continues with group activities related to air pollution for young people in Salvador, Bahia.

We held workshops with the community to present and plan the project's actions. There, we explained how the sensors operated to monitor air quality and about the toxic components they measured: nitrogen dioxide, sulfur dioxide, and ozone. In addition, we evaluated humidity, the number of heavy metals by each biomonitoring method, and the ambient temperature. The community helped choose the locations and assisted with installing the equipment. We installed four sensors in the

territory of Ilha de Maré, four in Subúrbio Ferroviário, and one in Ilha dos Frades. After establishing baseline data, we will use the results for studies of the sensors' measurements and the responses to them on impact on the health of the community.

Image 2: Health Fair at Terreiro Casa Branca in Salvador, September 2022

Photo: Ascom.

Ilha de Maré is in Baía de Todos os Santos, or All Saints' Bay, a district of Salvador, Bahia. In 2010, it had a population of 4,236 residents. The island's inhabitants are mostly preto or pardo, which is black or brown, 29.84% and 63.15%, respectively. The island has a very low municipal Human Development Index; 16.39% of the population over 15 years old is illiterate and has an average nominal income of $677.6 Brazilian Real per permanent private household, which is $134.64 American dollars, in addition to deficits in sanitary sewage (Conder/Informs, 2022). Fundação Cultural Palmares, or The Palmares Cultural Foundation, recognized the existence of Quilombo Remnant Communities in the area, certifying the communities of Bananeiras, Praia Grande, Martelo, Ponta Grossa, and Porto dos Cavalos of Ilha de Maré (Fundação Palmares, 2022). These com-

munities carry out fishing activities and mariscagem, which is the gathering of shellfish. Doing this exposes them to a series of occupational and environmental risks, which includes marine life scarcity, contamination of fish, environmental pollution, poor labor infrastructure, potentially deadly accidents, and food insecurity (Caroso, Tavares; Pereira, 2011). The proximity of Ilha de Maré to the Port of Aratu causes socio-environmental impacts in the region. Environmental degradation caused by the release of toxic gasses and an increase in respiratory symptoms associated with air pollution reported by the local population (ENSP, 2022).

Image 3: Ilha de Maré in May 2022, Salvador, Bahia, Brazil.

Photo: Cassia Souza.

We developed actions in Salvador's public schools, USF Beira Mangue, USF Antônio Lazzaropo, and through events such as the FIOCRUZ Science Fair and at the Terreiro Casa Branca Health Fair.

This project made it possible to promote educational actions through lectures and classes for young people and adults that raised awareness of air quality. In the beginning, various demands and ideas arose to publicize the educational plan for environmental pollution and planetary health in public schools around Salvador and Ilha de Maré. Considering

this, we carried actions out in public schools, the Federal Institute, and Basic Health Units. Our first expedition brought us to the Municipal School of Paripe, in the Paripe district of Salvador. With help from the professors, we installed air quality sensors in this location.

Protecting the environment to avoid damage was a priority. After completing the installation, we configured the device with the help of electricity and a Wi-Fi network. We collected the data with a system that reports its real time findings on a dashboard that is easily accessible via mobile app or computer. The educational activities included a demonstration of the portable sensor device's digital display, which measures atmospheric carbon dioxide levels, and a presentation that discussed biomonitoring with Tillandsia usneoides, or Spanish moss. Each of these was conducted by Planet&Ar in schools to help children discover what makes up a healthy environment based on the pillars of planetary health.

On August 18th, 2022, eighty-five students visited Fiocruz Bahia, originating from the state schools Raul Sá, Cosme de Farias, Central da Bahia, and the Instituto Central de Educação Isaías Alves (ICEIA), in Salvador. The Planet&Ar project could carry out scientific experiments, offer an oral presentation on air pollution, and share the project coordinated by Dr. Nelzair Vianna, which is currently in progress. There was also a demonstration of the polluting gasses present in the atmosphere that cause damage to life on Earth. To deepen the comprehension of the students, we showed the air quality monitoring sensors used in this research. At the end, they could also visit Fiocruz Bahia's research spaces.

The Planet&Ar project promoted the visit of medical students from the Federal University of Juiz de Fora, Health and Medical Sciences College of Juiz de Fora, and the Federal University of Bahia to Ilha de Maré. The goal of this project aimed at increasing medical education in planetary health. 2021 saw a primary reconnaissance made in three concentrations: economy, culture, and environment, relating each of these topics to the health of the local population. We visited churches, basic healthcare units, ports, beaches, and residences on Maré Island. During our second venture in

July 2022, students were divided into groups and accompanied by community health agents. Together, they collected questionnaires from the local populace, aiming to understand their perception of socio-environmental changes on the island and how they affected the quality of life, health, and economy of the region. Plans for a third visit are in the works.

Image 4: Students taking part in the scientific dissemination event in August 2022

Photo: Cassia Souza.

For those who wish to build educational actions in planetary health, we leave the following message: Amidst daily clashes, one should not abandon hope for building a fair and sustainable planet for our global

society, not least because environmental education is extremely important for the future of children and young people. It is not an easy task to undertake, however, simple gestures, such as reducing light consumption, decreasing water consumption, waste sorting, recycling, and reusing materials all contribute to the preservation of the environment, which help preserve the planet as a healthy environment for future generations. This fight is not new, nor will we be able to win overnight. The best way to combat nonchalance for the environment and our health is to educate and pass on knowledge to the children and young people who will be our future leaders on climate issues.

CHAPTER ELEVEN

United for Climate Project:

Climate Change and the Youth of the City of Salvador, Bahia

AUTHORS
Cássia Flávia Moreira Souza, Catarina Lorenzo, Iane Kathleen, Lívia Chaves Marcolin, and Maíra Dantas

The group, United for Climate, known as *Unidas pelo Clima* in Portuguese, is an initiative of five young girls and women from the city of Salvador, Bahia, Brazil. Our goal is to share ideas about climate change and bring the agenda to the youth in schools and communities in our city. Learn more about each one of us and our group below:

I am Maíra Dantas, a citizen of Planet Earth for twenty-six years who has a deep sense of caring for all the beings that live here. I am a surfer, yoga student, and practice agroforestry in my apartment!

My father instilled an admiration for nature in me from an early age. In our family home on the southern coast of Bahia, he taught me about the movements of the moon and the tides, about the trees and their fruits, about the winds and the animals, and shared his concerns about the problems of the Anthropocene era. It was these critical experiences that awakened in me a veneration for nature that strengthened into a feeling of respect and care for Mother Earth as I grew up.

I have a law degree from the Federal University of Bahia, and through my experiences at the University, I developed a critical eye on the unsustainable facets of capitalist society. In my academic career, I participated in movements that dialogued with the theme of city rights, orienting my studies to the instruments of urban public policy that truly speak to environmental causes. Since joining the university, I have been part of organizations formed by young people. Through AIESEC, a global organization spearheaded by youth and focused leadership development, I volunteered in Colombia, assisting with environmental education for children in a suburban Cartagena school. I saw the power of young volunteers as agents of change firsthand. After I graduated, I entered the post-graduation course in environment and sustainability at Fundação Getulio Vargas, where I found innovative solutions that were already

being promoted towards the transition to a sustainable future.

Today, as an activist, I am part of the youth organization *ENGAJAMUNDO*, which connects people all over Brazil in favor of environmental causes and their intersections. As a legal professional, I am a case analyst for the Institute of Environment and Water Resources of the State of Bahia. A few months ago, I had the pleasure to meet Catarina, Livia, Iane, and Cássia, and together, we started the project United for Climate, which I am proud to be part of, alongside such inspiring girls and women.

My name is Lívia Chaves Marcolin, and I am twenty-four years old. I was born in São Paulo, Brazil and currently live in Salvador, Bahia. I consider myself a world citizen because I grew up on my family's sailboat for eight years, an experience that allowed me to see over forty countries.

Living on a sailboat made me understand not only the importance of preserving the environment and the seas but also the need for harmony in the relationship between human beings and nature. As a surfer, sailor, and inhabitant of the sea, my life goal is to work for the benefit of the environment and do my best to facilitate its preservation.

I have a bachelor's degree in humanities from the Federal University of Bahia, which is where I am continuing my studies in law. I was involved in a scientific initiation centered on animal rights while at the university. Afterwards, I joined a research group coordinated by Professor Andréa Cardoso Ventura, Governance for Sustainability and Low Carbon Management. My area of focus was urban resilience and environmental and climate justice. Subsequently, I realized that, while academic actions are valuable, they do not reach the community directly; I wanted to work with the community. I became part of the movement, Fridays for Future Brazil, through which we demand climate justice in the streets, besides having

joined collectives such as Mulheres Unidas pelo Clima, or Women United for Climate, and completed a course on Climate Advocacy promoted by Election Climate. Currently, I am an intern at the federal public prosecutor's office at the Environmental and Cultural Heritage Prosecution Office, where I am learning how to deal with environmental litigation in practice.

During the climate strike that I promoted with activist Catarina Lorenzo, I met Maíra, Iane, and Cássia. This meeting provided us with discussions that served as a foundation leading to this incredible project of instilling environmental education in schools. We mutually agree that the solution lies in raising awareness amongst the population who will suffer most from climate change: the youth.

My name is Catarina Lorenzo. I am 15 years old and was born in Salvador, Bahia, Brazil. Even though I was born in this area, I grew up traveling between the city and the countryside of southern Bahia. I am a surfer, activist, and I love nature with all my heart.

I have a life greatly influenced by nature. Since I was a little girl, I grew up in contact with the great outdoors, and my parents always encouraged me to live in harmony with nature. I began surfing at the tender age of two, creating an early bond with the ocean. This has made me realize many things about the state of the ocean, such as increasing counts of plastic particles, rising water temperatures, coral bleaching, sewage, and other climate change consequences. When I was born, my grandfather and my parents were part of the movement to preserve an area of the Atlantic Forest called Vale Encantado in the city of Salvador; for this reason, I continue the fight today.

These experiences, along with my local living and actions, practices instilled in me as a child, brought me one of the greatest opportunities of my life: going to the United Nations with fifteen other young people,

including Greta Thunberg and Alexandria Villaseñor, where I signed a petition in a UNICEF committee against five countries. Later on, I had the chance to speak at the UN, demanding actions from world leaders concerning the climate crisis, emphasizing on the consequences for global youth. This experience opened doors for me, taught me various lessons, and encouraged me to continue acting for the cause. Because of it, I have become a global activist, meeting people and groups that have changed my life.

Today I am part of various organizations, like Heirs to Our Oceans, High Seas Alliance, Eco Club Sustentare, SOS Vale Encantado, and GAM Youth for the Decade of Ocean Science. In 2020, I was appointed a Young Eco Women Ambassador. I continue to do both individual actions and those in partnership with projects, such as the Strike for Climate. I am grateful for the incredible opportunities that have come into my life and the people I have met along the way. I hope that our present will create a strong future, and I appreciate my four incredible collaborators who have helped to intensify my optimism.

My name is Cássia Flávia Moreira Souza. I am 32 years old and a native of Salvador, Bahia, Brazil. Although some people do not value the air they breathe, being close to nature has always been one of the most pleasing aspects of life for me since I was ten years old. I appreciate nature and all its expressions, long maintaining concern for keeping the environment pure. For instance, one thing of particular importance to me in combating planetary health issues is the necessity of separating refuse according to each specific type of waste.

My undergraduate degree is in biomedical science from the University Maurício de Nassau, I have a postgraduate degree in cellular and molecular biology from College Venda Nova do Imigrante (FAVENI), and I am

concluding another degree in biology at FAVENI, keeping me in constant touch with the environment through learning.

Previously, I worked as a volunteer at CAASAH, which is a civil society organization that assists HIV and AIDS positive adults and children in social vulnerability contexts. Its major mission is helping people affected by these diseases through the full use of the facilities, improving the quality of life of whom they serve. They promote awareness, prevention, and reduction of STI/AIDS. They also stand for the defense, establishment, and guarantee the rights of people living with HIV. Finally, I volunteered at Parque das Dunas, the largest urban park of dunes, lagoons, and sandbanks in Brazil that was built with an emphasis on sustainability. This locale preserves the dune and sandbank ecosystem within Salvador, which is the last urban spring in the country. I am also part of the group called United for the Climate.

Currently, as an activist, I have been raising awareness through Planet&Ar, a project in which I am a scholarship holder, which is funded by Fiotec and supported by the Oswaldo Cruz Foundation (FIOCRUZ). In this project, biomonitoring was performed to measure air quality using a species called *Tillandsia usneoides*, widely known as Spanish moss. lha de Maré and the metropolitan region of Salvador received this biomonitoring for four months, after which, the plants were removed and sent for analysis, where they identified the particulate material types. The analysis occurred at the Pontifical Catholic University of Rio de Janeiro

It is worth mentioning the importance of effective air quality control that brings benefits not only in economical, environmental, and landscape aspects but also improves the life quality of the citizens.

I am Iane Kathleen, a seventeen-year-old high school junior in the Paripe district. I was born in Salvador. I do a bit of

everything; sing, learn how to play guitar, dance, and act in drama school. My outdoor interests include rappelling, rollerblading, and athletics.

I became an activist organically, as my relationship with nature has always been of great admiration and respect. Over the years, I studied the veganism cause and fell in love with it. From that point on, questions and doubts emerged regarding health and environmental impact. The complete indifference of the government caused me great indignation.

This year, for the first time, I had the chance to explore a subject called Health and Environment with my dear teacher, Quênia Lopes, at Professor Carlos Barros public school. I had held a previous acquaintance with the biology teacher, Cybelle Lobão, for four years. These educators motivated me to continue in this fight for learning. Today, my drama classes prepare me for greater comfort and fluency when speaking in public about the issues I am passionate about. I participate in other projects concerning the environment and health, such as the Salvador Climate Forum and Planet&Ar at Fiocruz.

I met the group during my first climate strike in Salvador. This experience was meaningful because I could talk to people who understood the gravity of the issue and who were a part of the fight for our collective future. This meeting renewed my hopes for my generation. Today, everything I do is for the environment. I feel that there is still a lot of work to be done. However, through meetings, lectures, and projects, I am meeting people with whom I have common interests. I know and feel that I have found my path.

As mentioned, the group met in the global movement called Strike for the Climate, promoted by the organization, Fridays for the Future. During the action, we shared our discontent about society's stagnation on climate change, particularly because of inaction of key decision-makers. On that day, we raised several questions and shared reflections about spreading already available scientific knowledge concerning the effects of global warming on human and non-human life. More than just disseminating science, we wanted to make people aware of their rights so

that they could promote public policies focused on climate change mitigation and adaptation in their local communities. Therefore, we felt that the best possible way to spread this essential movement would be through education.

As young activists, students, researchers, and professionals, we feel prepared to start a project that speaks to the people most likely to be affected by the imminent climate crisis, the youth, especially those who live in larger cities. We want to share the knowledge on the climate crisis and expose its causes and effects, going through historical and contemporary global political, economic, and social mobilizations. By doing so, our goal is to awaken a critical view of the young people's reality, enabling them to recognize themselves as part of this great interconnected web that is Planet Earth.

According to the World Cities Report, released by the United Nations Human Settlements Programme in July 2022, the future of humanity is undoubtedly urban. While in the 1950s approximately 25% of the world's population lived in cities, by 2022, this percentage had doubled. Over the next fifty years, it is estimated that cities will be home to 58% of the world's population. As major consumers, producers, and polluters, cities and their young inhabitants must be informed and prepared to adopt a resilient and proactive position towards emergent environmental challenges that, eventually, will affect us harshly. Our initial approach is starting with rich environmental education in schools, both public and private, mainly for high school students in Salvador, Bahia. Our work aims to raise awareness and mobilize adolescents to act on behalf of socio-en-

vironmental justice through educational actions, taking environmental climate consciousness and knowledge to the schools of Salvador, Bahia. This project was also a way to nurture a hopeful sentiment for the future.

Considering that our target audience consists of teens, we concluded that the classic lecture method of the students remaining seated while the teacher stands in front of the board would cause disinterest. To circumvent that, we settled on a different approach. We strive to understand the students' needs and interests in each class so that our work is engaging and enlivening.

We plan to do our first activity at the Professor Carlos Barros public school, in the Paripe district of Salvador. Group founder and participant Iane is a high school junior at this campus, which has a study track called Health and Environment. The idea is to use this space to organize a meeting with her classmates, ensuring that activities are connected to this area of academic focus.

We spoke to school teachers who advised us on ways to approach the topics in the classroom. In an interview with professor Iracema Reimão Silva, who teaches global climate change at the Federal University of Bahia, we prepared a questionnaire. One question was: How can we awaken the students' interest in the meetings? In response, the professor drew our attention to the importance of debates, highlighting the potential and importance of engaging students in discussions. We thought of approaching this issue in a more playful way, sometimes with rounds of conversations and debates, sometimes with educational actions that get hands-on.

We can develop a methodology that lauds interaction in its essence. To achieve this, we plan to start with a round of conversations that allow us to get to know the interests and particularities of the participants. As time progresses, we intend to introduce interactive games, both virtual and non-virtual, to draw the students' attention to the topics covered. Some of the game suggestions include:

- Developing online quiz game to be run in class, like Kahoot, with the

suggestion that teachers award extra points to the students

- Write assorted effects of climate change that occur throughout parts of Salvador on paper strips and have students draw one, discussing if they have observed the particular phenomenon in their community or if they are familiar with someone who has contended with it
- Make relevant information available in the classroom with lots of color, images, and simple graphics.

After we defined the method that we will use in the classroom, we defined which topics to address in the meetings. For optimal organization, each member of the group was to suggest up to three topics that are related to the daily lives of the young people affected by our actions. At the end, we met to discuss the proposals presented.

We decided that the first part of our sessions will focus on familiarizing young people with the subject of climate change, summarizing the topic, its causes and global consequences. We move on to a historical overview of events that have marked the trajectory of related studies and contributed to elevating climate change to a level of global concern. Our aim will include weaving in a review of international treaties aimed at addressing climate issues, such as The Paris Agreement. The last component of our introduction concerns the present, showing young people they can be agents of change in the places where they live now, enforcing the idea that local actions can lead to global impacts. After this, we will then address our three courses: Climate Change & Cities; Climate Change & Food Security; and Climate Justice & Environmental Racism. In our future meetings with schools and communities, we will address one subject at a time. Despite the relation of the subjects, the goal is to focus on minute points within each issue to streamline discussions.

The first topic we intend to address is Climate Change & Cities. When we created this topic, we designed it to show how urban lifestyles contribute to the worsening of the climate crisis to awaken a sense of responsibility in young people. It is important to present some points related

to the UN's Sustainable Development Goal 11 of Sustainable Cities and Communities. The media commonly treats climate change as though it is something that will occur in a distant future; our idea is to educate young people about global warming as a current concern and that our generation is already experiencing its effects. To do so, we will expose the effects suffered daily by the population of São Paulo that are related to climate change, such as the flooding and landslides caused by increasingly heavy rains, the heat waves that affect the population's health, and rising ocean levels Presenting the causes and consequences of the climate emergency related to urban living is important as it allows us to present students with local actions that have global rewards. We believe it is important to focus on taking action during these sessions, avoiding wallowing in helplessness or pessimism that can often accompany this topic. We maintain that the possibility of change still exists and share hope for a better tomorrow.

Meetings that follow will focus on the remaining subjects, Climate Change & Food Security; and Environmental Justice & Environmental Racism. The climate crisis has an immense impact on food production, which worsens the situation of food insecurity in Brazil, something that is historically tied to poverty and social inequality. With a course in Climate Change & Food Security, we hope to enlighten the audience, especially those who live in the periphery, on how the food on their plate influences, and continues to be influenced by, climate change.

In the Environmental Justice & Environmental Racism course, we discuss justice through the lens of the consequences of environmental disasters, especially those caused by climate change, and how they affect certain populations differently. Considering that these disasters are major causes of food insecurity, we cannot approach this issue without considering the need for environmental justice. We will review environmental racism, noting that the effects of climate change are more negative for nonwhite populations. This incorporates the demographics of the area, 80.2% of Salvador's population being black.

After forming the group, we held weekly meetings in order to expand the project. We have held our virtual meetings since April 4th, 2022, lasting approximately ninety minutes each. We use WhatsApp to communicate throughout the week and schedule upcoming meetings. At the closing of each meeting, we set the subjects to be covered in the next one. We created a shared document on Google Drive in which we placed suggestions of literature for discussion throughout the week. We wrote the agendas for meetings to aid in organizing the project and keeping people who could not attend specific meetings informed.

During our weekly meetings, we worked on our project and different approaches for enacting discussions and activities in the classroom. We started by defining the topics we are going to address, methodology to be followed, spaces to which we intend to extend the project, and group partnership opportunities. We are also promoting talks with professionals in education and climate who can exchange their experiences with us.

In July, after several online meetings, we realized that an in-person meeting would be necessary. We have had two such meetings, one in July 2022, and the other in October 2022. July's meeting occurred in a public park, where we shared a vegan picnic and discussed the issues we intend to work on throughout the project. In October, we went to an Atlantic Forest preservation area that is threatened, in the heart of Salvador, Bahia. We went on a guided trail walk led by Carolina Lorenzo and group member Catarina Lorenzo, who is also part of Vale Encantado, the collective that works to preserve the area.

Organizing an in-person meeting was not without its obstacles, particularly in finding places that are accessible to everyone. Salvador has neighborhoods that are far from each other, and public transportation is deficient in this zone.

In the future, we plan to learn from our first experience with the youth from Professor Carlos Barros public school and grow in our next knowledge exchange. We hope to see a big impact from our project, locally and globally. As we always say, local actions lead to global impacts and

can change the world. We hope we can become an example of positive change not only for this concept, but for society hoping to change the world for youth around the world.

MEETING DATE	TOPICS
April 4th, 2022	• Group presentation • Topic about climate change scope • Identify project's target audience • Methodology
May 2nd, 2022	• Meeting with Tatiana, a Professor at Federal University of Rio Grande do Sul and Planetary Health Alliance Researcher • Invitation to participate in the research on environmental education and planetary health through a report of our experiences
June 10th, 2022	• Debate about the presented ideas and topics elaboration • Three topics to discuss in meetings: 1) Climate Change & Cities; 2) Climate Justice & Environmental Racism; 3) Climate Change & Food Security
July 2nd, 2022	We discussed interconnections between people and the world by addressing: • Business companies • Environmental responsibility • Awareness • Marketing, internet, and media
July 23rd 2022	• Meeting with Professor Iracema • Presentations - Professor and team • United for Climate project presentation • Presenting the selected topics: Intro debate and Climate Change & Cities
August 1st, 2022	• Meeting with Professor Dr. Nelzair • Presenting the Planet&Ar project • Discussion on essential topics and tips for the project
August 5th, 2022	• Orientation meeting about the planetary health group text of Professor Tatiana
August – September 2022	• Meetings in order to elaborate the planetary health article
October 22nd, 2022	• In-person meeting with hike through Vale Encantado, a preservation area in Salvador, Bahia

CHAPTER TWELVE

Planetary Health and Intercultural Learning in a Residential Experience with K-12 Teachers

AUTHORS
Luís G. L. Arruda, Patricia Hermance, Jon Cox, Elizabeth Benson, Brian M. Griffiths, Mike Doody, Barbara Prillaman, Merry Ostheimer, Monica Cohen, Christy Tapert, and Cynthia Papettas

This chapter presents an initiative on continuing teacher development at the K-12 level. Several institutions collaboratively developed the proposal, in a hybrid format during the years 2021 and 2022, involving online lectures and residency experiences in different locations. It conceived nature as a learning space and focused on the connections between ecosystems in different parts of the planet and the cultures that flourish in these locations.

Delaware Teachers Institute

The Delaware Teachers Institute (DTI) is an educational partnership between the University of Delaware (UD) and five Delaware public school districts. As a member of the *Yale National Initiative League of Teachers Institutes*®, DTI follows a unique professional learning model prioritizing development of teacher leadership skills and increased educator content knowledge. Cross-grade level and cross-curricular groups of Fellows engage in seminars where university faculty members contribute their knowledge and expertise. Throughout the seminar experience, DTI Fellows apply their knowledge of elementary and secondary pedagogy, their understanding of the students they teach, and their grasp of best practices in the classroom while researching and writing related curriculum units. These units are designed to be used in their own classrooms, shared with others in their home schools, and accessible to a wider audience of educators through an online database.

Each year, DTI surveys teachers in partner districts to determine the focus of the upcoming seminars. For several years, teachers shared an interest in topics related to climate change, environmental science, and working with Indigenous communities. During the 2021 appeal for seminar proposals, Jon Cox, UD faculty member in the Department of Art and Design and President of the Amazon Center for Environmental Education and Research (ACEER) proposed a seminar entitled, “Bringing the Amazon Home”. The proposal outlined twelve sessions focused on interconnectedness, adaptation, and resilience inspired Fellows to connect

the lessons of the rainforest to the needs of Delaware's K-12 students. The DTI teacher steering committee enthusiastically accepted the proposal and recruited Fellows to take part. Because of public health concerns related to the Covid-19 pandemic, the seminars were presented virtually. While virtual seminars were a departure from the typical DTI model, they allowed for teachers to engage with scientists, artists, designers, storytellers, indigenous leaders, educators, and conservationists working in the Amazon rainforest. To amplify the connection between seminar topics and the local environment, they added a field experience in the summer of 2021. This three-day workshop connected Fellows to experts at the Stroud Water Research Center and the Lenape Tribe, indigenous to Delaware. After a successful 2021 seminar, the teacher leadership team extended this experience into 2022 to allow for deeper exploration of the concepts and a field experience in the Peruvian Amazon. Curriculum units designed because of this sustained, engaging, and empowering experience enable teachers to meet the demands of the Next Generation Science Standards (NGSS) and Common Core State Standards (CCSS) while elevating indigenous voices, integrating experiential learning, and inspiring the next generation of conservation leaders.

ACEER and Bringing the Amazon Home

The ACEER Foundation has been a dynamic force for rainforest conservation for over thirty years. It develops local and global environmental leaders who work to conserve and restore functioning landscapes in the Amazon Basin and beyond. They settled the foundation with a vision to collaborate on conservation issues with universities, schools, businesses, conservation organizations, and families. Today, ACEER operates as a global leader in experiential education focused on environmental issues and Indigenous cultures in the Amazon basin.

As part of their Bringing the Amazon Rainforest Home initiative, ACEER worked with conservation leaders to develop curricula that not only meet

the standards of the United States education system but also foster a mutual understanding between cultures and allow teachers and students to engage directly with ACEER's network of global professionals. The next generation of conservation leaders will come not only from Amazonia but from every region of the world.

ACEER collaborated with K-12 teachers, conservation leaders, NGOs, education administrators, citizen science organizations, naturalists, artists, and designers to propose a grant to fund the Bringing the Amazon Rainforest Home initiative. The Longwood Foundation and individual donors of ACEER partially financed the two-year project. The funding enabled participation from K-12 teachers in all three counties in Delaware, equipment purchases. Paid professionals worked directly with teachers and supported them in developing their educational content, which came from a network of professional scientists, conservationists, designers, cartoonists, animators, videographers, storytellers, and photographers.

This seminar inspired participants to develop innovative didactic and experiential education lessons for K-12 teachers so they may successfully meet state-mandated NGSS and CCSS. Each seminar had different themes and counted on invitees from inspiring organizations who take part in the enactment of sustainability education or environmental conservation, such as the Alliance for a Sustainable Amazon, Foldscope, Morpho Institute, Stroud Center, and National Geographic Society. The major goal of the seminars was to grant teachers access to different approaches, such as the NatGeo's Explorer Mindset Framework, and resources, such as the Foldscope's online community, to be used in their final prospectus.

Besides the thirty seminar sessions, Delaware K-12 teachers also took part in two outside field-based in-person workshops. In year one, teachers participated in a three-day summer institute, learning from Indigenous leaders and professionals in their respective fields. Teachers used hands-on methods to understand citizen science data collection and microscopy, water quality monitoring, camera trapping protocols, GIS mapping, best approaches to storytelling, bridging art and science

through cyanotypes, traditional ecological knowledge of medicinal plants, and regeneration of natural landscapes.

Ecotourism with the Maijuna

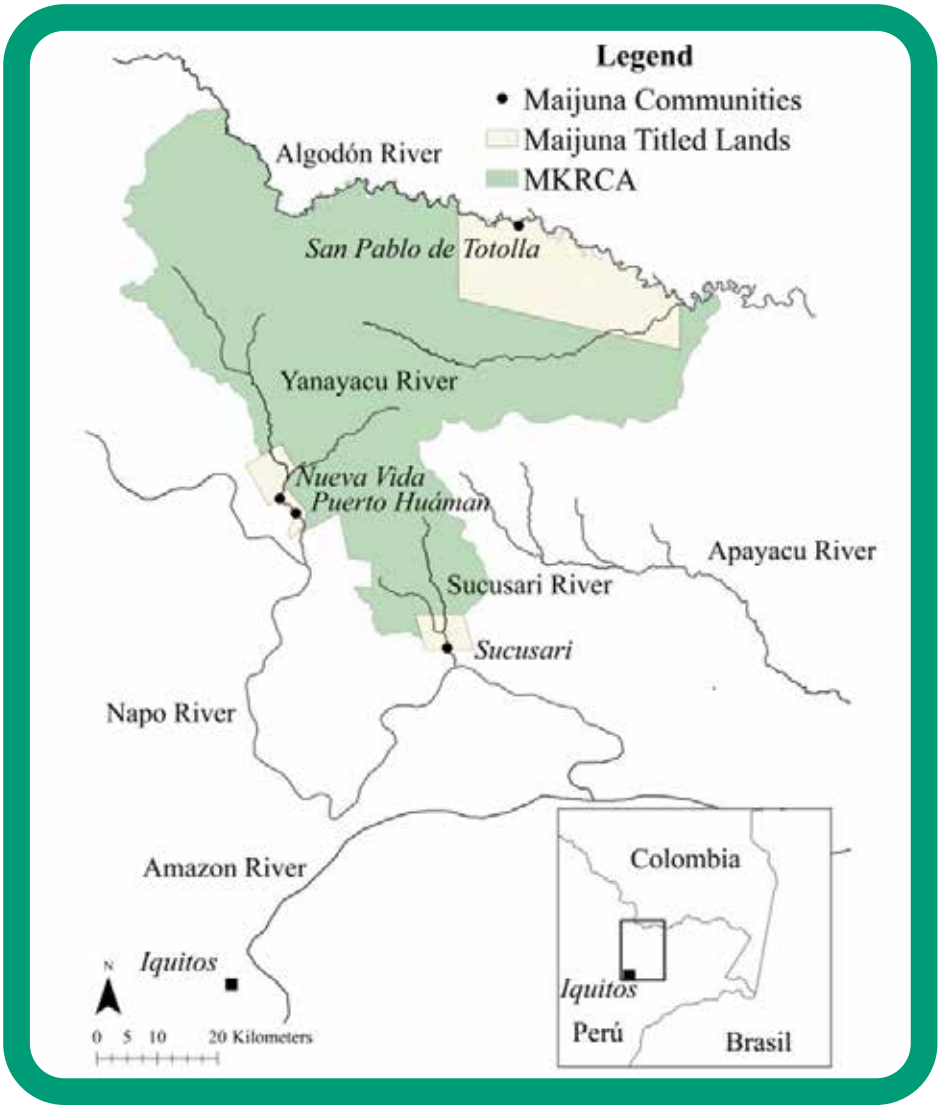
For decades, the Maijuna, an Indigenous group in the Peruvian Amazon, have been working with OnePlanet, an NGO committed to biocultural conservation, on sustainable economic development initiatives. One of these projects has focused on capacity building and development of ecotourism in the Maijuna community of Sucusari. Community members taking part in the project receive training on effective teaching, public speaking, and engagement of audiences, subsequently teaching topics related to daily life and culture of particular interest to them. Some examples of the topics covered by Maijuna instructors included sustainable agroforestry and farming; fishing; cooking; and the traditional Maíjìkì language, among others. The choice of lessons to offer and who will lead them was community driven. This framework has been established and operating for several years, and the participation of the DTI Fellows further expands this initiative. The project allows the Maijuna to earn a sustainable income to practice their own cultural traditions while providing critical environmental education.

The Maijuna-Kichwa Regional Conservation Area

The intercultural experiential learning program was a ten-day boat expedition to the heart of the Peruvian Amazon to the home of the Maijuna community of Sucusari, an area located 120 km northeast of the city of Iquitos, Peru (Fig 1). All the logistics were supported by Amazon Explorama Lodges. They hosted teachers at the Amazon Conservatory for Tropical Studies (ACTS) field station on the border of the Maijuna-Kichwa Regional Conservation Area (MKRCA) and titled lands of the Sucusari community.

The MKRCA legal demarcation represents a key success of the Maijuna struggle against development and exploitation. This area encompasses

Figure 1: Map of the Maijuna-Kichwa Regional Conservation Area (MKRCA) and the Maijuna community of Sucusari



almost one million acres of Maijuna ancestral lands, safeguarding keystone and understudied species that provide critical ecosystem services for the planet. The protected area was recently created in 2015, after the Maijuna, united as FECONAMAI, the Maijuna Federation for political representation, raised their voices against loggers and poachers. More recent enterprises, such as a highway proposal that would bisect their ancestral lands and the MKRCA, still threaten their environment, cultural traditions, and livelihoods in addition to their rights to self-determination. You can hear about the struggle against the proposed highway in the documentary, Guardians of the Forest (2020).

K-12 Teachers in the Amazon

In June 2022, after more than a year of planning, the cohort embarked on their expedition to the Peruvian Amazon. They dedicated the first day of the expedition to traveling from Iquitos to the ACTS field station on a three-hour boat ride. When teachers got to ACTS, they had free time to explore the facility and its surroundings. Later that night, there was a gathering to acquaint attendees, present the schedule, and review safety instructions. The meeting was mostly casual, aimed at informing those in attendance of the activities to help provide hands-on background in building their units.

The first morning started with preparation of several LeafPacks, a low-cost water quality test based on the types and diversity of insects found after submerging the packet of leaves in a river for several weeks. Collaborators would later extract the LeafPacks. Mike Doody, high school environmental science teacher, shared how much he enjoyed "searching for the optimal leaves for the LeafPack—not freshly fallen, but not too decomposed either." He continued:

> **Searching for leaves gave the group the opportunity to become more familiar with the different tree species and any insects living on the forest floor. Because of their cost effectiveness, LeafPacks are an excellent way of collecting data on stream quality while also getting students outside to ask questions, make observations, and collect data in their local ecosystem(s).**

In the afternoon, teachers visited the Sucusari community for the first time, where the community president, Everest, guided the group through the community's Cultural Interpretation Center.

The Center featured exhibitions in four different rooms, visuals that support a moderator's presentation, one of whom was Everest himself that day. Exhibits included a few handicrafts and panels with photos, maps and texts in Spanish, English, and Maíjìkì. The rooms covered subjects such as the historical timeline of the Maijuna; how Maijuna culture has changed in recent years and contemporary conservation practices;

their current struggle with deforestation threats and their efforts to address these; and a nod to the various supporting partners of Maijuna voices, from local political organizations to leading conservation scientists. After this presentation, a collective introduction took place in a maloca, which is a communal longhouse built for gatherings. The teachers and the Maijuna spoke their names and where they are from. After this brief introduction, there was a small feria, or fair, so that the Maijuna could sell their handicrafts to the visitors, an important, sustainable income source for the community. They typically aim the design of this first day schedule at ecotourists not committed to a longer-term cultural exchange program and those who are visiting Sucusari for a half-day excursion. For the visiting teachers this served as a glimpse into how the Maijuna engage with tourists. For the remaining days of the week, the schedule provides deeper lessons and connections than are available to tourists.

The next day began with a hands-on experience of traditional fishing. Two Maijuna fishermen demonstrated three different techniques: setting traps (Image 3), using the *barbasco* plant, and a net. After catching some fish, two Maijuna women invited us inside their kitchen and showed us how to prepare the fish with dishes like *patarashca*, *pescado dormido*, and *pango*. After lunch, they divided Fellows into two groups to take part in simultaneous activities, switching after completing their respective tasks. One of them was a hike in the forest with Maijuna elders, where they highlighted both the quantity and diversity of plants with traditional uses and described their utility. This area boasted palms with fibers strong enough to create items ranging from hammocks to bracelets in addition to mosses that can stop bleeding (Image 4). The other activity was a lesson by the last Maijuna shaman, Pedrito, and his wife, Amelia, on medicinal plants, spirituality, and the multitudinal connections between. Barbara Prillaman, a high school sociology teacher whose unit focuses on the intersection of traditional and modern medicine shared this reflection:

> ***After researching information about shamanism for over a year, it was a true honor to be in the presence of Pedrito! To speak with***

him one-on-one and see his work in action, from his perspective, was a true gift. I cannot wait to share the video and interview excerpts as well as photos with my students. Bringing the Amazon home is made so much easier from this on-site experience.

Image 2. Setting traps with live bait to catch catfish

In the evening, teachers had an introduction to Maíjìkì expressions and vocabulary. Held at ACTS, the class led by Sebastián, commonly known as Shebaco, a Maijuna elder and Maíjìkì expert. His review included the nuances of pronouncing the nasal sounds and vowels critical to Maíjìkì. He also taught key phrases like *nui chibayi*, which translates to, "I'm very happy", a common phrase from Sebastiá,) and *deobese ñami*, which means, "Good evening." We invited community members who led activities to have meals with the crew and DTI cohort, a practice that occurred each day of this immersive excursion.

The following morning, teachers took part in beekeeping. Stingless bee hives are small wooden boxes kept near community members' houses. Traditionally, the Maijuna would destructively harvest stingless bee honey by chopping down the hardwood trees where they naturally occur; now, the bees are managed sustainably. Merry Ostheimer, second grade teacher, described:

Listening in awe as our Maijuna host explained they used to go into the jungle, listen for buzzing at night, and then return the next day to collect honey. This practice destroyed the colony and required a lot of time and energy. Several years ago, OnePlanet began working with the Maijuna to change their strategy of harvesting honey to a more sustainable one: by cutting the nest tree down, they could carry the trunk back to their village, and raise the colony in their own backyards. When the meliponines population grew, the Maijuna could divide it, keeping some of the hive in a section of the tree trunk and move the rest of the hive into a small bee box.

Stingless bees hold an important place in Maijuna traditional culture, featured in a traditional dance and chant. Maijuna beekeepers, who opened the boxes and explained about the hive's structure, its maintenance with clay and wax, and how to extract the mature honey with sterilized syringes led the lesson. Ms. Ostheimer said:

Watching the bee activity was so mesmerizing that I didn't realize my hand was near the hive. Suddenly, I felt a powerful shock! I thought I got stung, but then I realized that what I felt was the rapid vibration of the bees' wings beating. The tiny and quick Tetragonisca angustula bee hive was so fascinating! It was unlike any other hive I'd ever seen. It was off white and looked kind of like crumpled paper. Seeing the busy bee activity, tasting the sweet honey, feeling the slight wisps of air stirred by the bees, all without being stung, was one of the most amazing things I've ever experienced. I feel so grateful to have the opportunity to visit the meliponary and see the symbiotic relationship between humans and bees.

That afternoon, the cohort returned to the community for a workshop on preparing the traditional drink masato, a lightly alcoholic fermentation of *manioc*, or yucca. Victoria and Lisbiana invited the cohort to their kitchen and presented the raw root and how to peel and cook it. As the yucca cooked, the hosts provided previously made yucca in order to show the subsequent step of grinding it down with the *moledor* in an enormous

wooden trough called a *batang*. They smashed the boiled yucca into a thick pulp with much effort from our Fellows. The fermentation process was then started by chewing several mouthfuls of the mashed yuca and spitting these back into the *batang*, a critical step that is only done by women in the community, therefore only the women in the cohort. The fermentation occurs over two to nine days, depending on the desired final taste, texture, and specific traditions of each family.

Image 3: Agapito during the forest hike showing teachers how to weave palms leaves for sustainable thatch roofing.

The next day's activity was a long boat ride to a particular site in the MKRCA's forest, a tuara in Maíjìki, or a mineral lick in English. Mineral licks are naturally occurring spots with exposed subsoil that contain a rich mixture of minerals and clay and myriad geophagic animals gathering to consume soil. These are special places for the Maijuna as they represent important hunting spots and a window into Maijuna traditional culture. After a brief hike, they invited teachers to see the licks, where they were introduced to its ecological characteristics. Monica Cohen, a high school biology teacher who visited two mineral licks during her time in the rainforest, remarked on their diversity:

Having experienced two different mineral licks, I noticed how one was very swampy with water up to your knees, while the other was just soft clay around your feet. In both locations we were able to see where the animals entered and where they dug to eat the mineral-rich soil.

Then, a traditional narrative was told by Shebaco about the creation of the first tuara, the first tapir, and their relationship with the first masato ever made. This narrative unites many aspects of Maijuna culture, synthesizing relationships between multiple natural and cultural elements that the teachers saw in previous activities. The afternoon was dedicated to traveling back to ACTS. That night, the group had a casual debrief on the experience. Beyond deep inspiration and admiration, teachers reported frustrations with their Spanish abilities.

The next morning started with a visit to a farm called a chacra, where a family was growing a host of crops that included yucca, bananas, plantains, cacao, pineapples, aguaje (*Mauritia flexuosa*), and cocona (*Solanum sessiliflorum*). After an introduction to the chacra, the teachers were divided into groups of three, each of which was led by a Maijuna expert. The educators learned about Maijuna traditions and how the chacra is maintained. They reunited the subgroups for hands-on practice planting and harvesting yucca and several other crops. Afterwards, they enjoyed savoring the fruits of their labor during lunch. Later, teachers returned to the community for a traditional canoe building session.

The next two mornings consisted of workshops on traditional artisanry, which covered gathering the materials and crafting products. One workshop was on traditional clay pottery called kuakoro, which united a specific soil and tree bark ash. Once the clay was prepared, Nancy, a Maijuna elder who specializes in crafting kuakoro, showed the teachers how to make a small pot. Christy Tapert, an elementary art teacher, gave a glimpse into the profound influence of this experience:

As a Delaware Teachers Institute Fellow, I had the awesome opportunity to witness, participate, and experience a time-honored tradition of pottery making, known as kuakoro, in the Maijuna com-

munity. Although the process of forming the clay into a coil bowl is much the same way we as teachers/students do it, it amazes me that Nancy, a Maijuna elder and pottery teacher, collected her clay as a natural resource from the river. This elderly woman would dive into the river and feel with her feet and hand for clay on the river bottom. She would then perform the labor intensive act of digging it out. Most of the elementary teachers that I know who teach clay have heavy fifty pound boxes delivered. Nancy would mix her clay with a specific soil and tree bark ash that was burned and mashed into a black powder. Our DTI team was invited to participate in that process. We sat alongside a 16" board and mixed and rolled our clay as Nancy checked our process, technique, craftsmanship, and clay consistency, giving us direction. Around us, the community watched, and the children wanted to participate. I gave my clay scraps to a little girl, approximately 6-7 years old, and watched as she modeled after my clay coil bowl. As explained to us, the tradition of kuakoro is fading out in this community as Nancy is the only person left to teach it. Many of the young adults don't take interest. This brings to mind David Sobel's quote, 'If we want children to flourish, to become truly empowered, let us allow them to love the earth before we ask them to save it.' I believe that teaching the children kuakoro could help save the tradition. The delight in playing, forming, and experimenting with the clay can go a long way towards their love for it.

The accompanying workshop showed the uses of natural palm fibers, starting with collecting them in the forest, staying aware of the chambira's many spines (Image 4). Cynthia Papettas, second grade teacher, reflected how much she learned from Maijuna community members, Delia and Magnolia:

They taught us how to cut chambira palm using a machete, and how to shake the palm spears to release their fronds. Within those fronds were even smaller fibers that get manipulated to create hammocks, bowls, purses, and more!

Teachers then learned how to cook, dry, and prepare the fibers for dying. They were also taught how to mix natural dyes such as turmeric to create vibrant yellows and orange, and *huito*, a plant processed for blue dye. Next, they covered the complex primary weaving process and how to craft fibers into products including bracelets, hammocks, and ropes.

Image 4: Gathering natural fibers from *chambira*, careful to avoid its many spines

As Ms. Papettas reflected upon the experience, she noted:

> ***Teachers can really benefit from sharing with their students the wonderment of plants and how diverse their usage can be, such as food from their fruit and furniture from their dried leaves. Learning about the process of harvesting and using chambira palm can be super engaging and is a great way to share culture with students. I am very thankful for the knowledge I gained from my professors in Sucusari about different plants and what their benefits are to the Sucusari community.***

During these afternoons, teachers had free time. Educators spent their time getting to know their Maijuna professors in greater depth, interviewing specific community members, exploring ACTS facilities and canopy walkway, or simply resting. This relaxed environment was critical in creating bonds, especially during the last afternoon in the community which saw everyone compete in a soccer match (Image 5). After that, in

aims to strengthen the community school's library resources, a donation of hundreds of books on natural sciences, collected by ACEER Conservation Fellow, Rut Mottoccanchi.

Image 5: Creating bonds and having fun during the final afternoon.

Once teachers returned home, DTI hosted seminars, aiming to polish the units they crafted during the seminar. These fall sessions helped Fellows connect their field experiences, newly developed content knowledge, and multimedia resources to their standards-based curriculum unit. Teachers also took part in an evaluation process, which included a pre and post-program survey evaluating cultural competence.

Final Remarks

The Planetary Health Education Framework (Guzmán *et al.*, 2021)[1] provides rich perspectives on the interdisciplinary characteristics of a social-environmental and planetary contextualized education. With a focus on "interconnections within nature" and "equity and social justice" as domains, intercultural education approaches can highlight the deep relations between Indigenous applications for planetary health and natural laws,

1 Guzmán, C. A. F., Aguirre, A. A., Astle, B., Barros, E., Bayles, B., Chimbari, M., El-Abbadi, N., Evert, J., Hackett, F., Howard, C., Jennings, J., Krzyzek, A., LeClair, J., Maric, F., Martin, O., Osano, O., Patz, J., Potter, T., Redvers, N., … Zylstra, M. (2021). A framework to guide planetary health education. *The Lancet Planetary Health*, 5(5), e253–e255. https://doi.org/10.1016/S2542-5196(21)00110-8

as previously posed by Redvers *et al.* (2020)[2]. Then, educational activities hosted by Indigenous communities, on their own sacred lands, might provide opportunities for novel approaches in planetary health education.

In this sense, the internal evaluation shed light on the teacher's perception shifts through participating in this residential experience in three notable ways: i) the improvement in affective values related to bonding through talking about one's own culture and hearing about others; ii) the provision of insights on the demands, challenges, and strategies to foster NGSS guidance on these topics; and iii) furnishing experiences and reflections about cultural competencies and strategies for teaching it with adequate materials and NGSS-aligned strategies. All the teachers reported the expedition met their expectations, two-thirds of which went further to report that the trip exceeded them.

Finally, we recommend having a predefined commitment to ethics while collaborating with Indigenous communities. Rejecting a neocolonialist heritage of western cultures becomes fundamental to the function of this sort of collaborative educational proposal; ACEER provides a fine example of this approach in their Ethics Policy commitment. The workshops and training in this program were conceived, directed, and led by the Maijuna, providing them a platform to choose what they want to teach, and to whom. This community-driven approach was critical to the success of the program.

2 Redvers N, Poelina A, Schultz C, Kobei DM, Githaiga C, Perdrisat M, Prince D, Blondin B. Indigenous Natural and First Law in Planetary Health. *Challenges*. 2020; 11(2):29. https://doi.org/10.3390/challe11020029

CHAPTER THIRTEEN

Educational Knapsack (Alforja Educativa): An Opportunity to Connect Planetary Health and the Microbiological World with Children from Latin America

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Education as a tool for change and empowerment is one of the primary strategies in preventing antibiotic resistance. In the spirit of collective construction, involving multiple groups is essential, whether that is health professionals who have a strong, multidisciplinary educational perspective or educators with a critical and integrated health view. Embedding multidisciplinary support creates an instructional approach that is accessible to young learners while informing them of the vital relationship between human health, bacteria, and Mother Earth.

Alforja Educativa, known as the Educational Knapsack in English, is a partnership between ReAct Latinoamérica[1] and *El Centro de Capacitación, Estudio y Difusión Niño a Niño*[2] in Cuenca, Ecuador, which is The Child to Child Training, Study and Dissemination Center in English. Alforja Educativa results from health promotion work done by El Centro Niño a Niño, multiple investigations, actions, and the volunteer and activist work that members have carried out for thirty years in Ecuador and in over 150 countries around the world over the past forty years. ReAct contributes by approaching more science-heavy content, incorporating the topics of the microbial world, something not commonly addressed with learners as young as infants or in training spaces with educators. This combination has been of great value for the success of Alforja Educativa as it points to the relevance and interconnection of its subjects and its methodological proposal.

To start its creation in an interdisciplinary and inter-institutional way, health professionals, educators, artists, writers, and children were involved. They also reflected this richness in the diversity of the produced material. Over five months, a group of forty-two teachers who taught in private, public, and intercultural setting throughout the city of Cuenca, Ecuador were invited to meetings to assist in preparing guides, revising relevant curriculum on these topics, adapting concepts, prototyping the activities to inform what we now have as activity guides.

1 ReAct is a global network, created in 2005, that promotes initiatives and encourages action on antibiotic resistance. With hubs on five continents, it collaborates with academic institutions, communities and public policy makers, sharing information, stimulating global commitment and driving collective initiatives.

2 The *Niño a Niño* Foundation is a non-profit organization that was created 30 years ago in Cuenca by a group of health and education professionals with a profoundly empowering approach and actions towards children.

Initially, the Alforja Educativa was solely activity booklets. The past decade has seen an expansion to include media that supports multi-sensory learning, such as videos, stories created by the children themselves, songs, comics, board games, and updated guides that include new contributions to this field.

"Child-to-Child" Methodology: a Powerful Tool to Change the Way we Look at Children and Abandon "Adultcentrism"

The child-to-child method adds to basic education and health knowledge. From a critical point of view, meaningfully observing and engaging with their natural surroundings encourages self-reflection in children. This creates actions that are active and responsible. Moving perspectives towards an approach such as this allows us to view children in a way that empowers them to be agents of change in their schools, families, and communities.

There is considerable discussion about children's rights, however, challenges lie in implementing them, such as the right to participation and free expression [3], articles twelve and thirteen of the United Nations Convention on the Rights of the Child. It is important that they get involved in issues concerning the opportunity to experience other rights, such as those of education, health, living in an adequate environment, and the integral development of their capacities.

Within the context of formal education, the child-to-child methodology contributes to didactic development, showing that there are alternate ways of learning in both adults and children, and building knowl-

3 Article 12: Parties shall assure to the child who is capable of forming his or her own views the right to express those views freely in all matters affecting the child, the views of the child being given due weight in accordance with the age and maturity of the child.
Article 13: The child shall have the right to freedom of speech and expression; this right shall include freedom to seek, receive and impart information and ideas of all kinds, regardless of frontiers, either orally, in writing or in print, in the form of art, or through any other media of the child's choice. Available at: https://www.un.org/es/events/childrenday/pdf/derechos.pdf.

edge about health at school, comprehensively that closely connects different content areas.

These ten years of Alforja Educativa have been an incredible learning experience. Guided by this resource, several community agents have conducted countless actions that have improved educational activities in which the children are active protagonists.

Alforja Educativa *in Expansion*

The Alforja Educativa resources were developed in Ecuador. This was the first locality to implement actions based on its material, and its message spread quickly.

Workshops, seminars, and meetings were held with attendees from various academic, social, and government organizations. Countries represented included Argentina, El Salvador, Peru, The United States, and Bolivia. In addition, they translated the guides into English and adapted it for two Kenyan counties, a collaboration with a hub of ReAct Africa. The Quilloac Educational Unit, a Cañari community institution serving native Ecuadorians, translated and adapted the materials into their locally spoken language, Quichua. In 2022, the project of translating and adapting for a Brazilian context began, developed by the Group of Advanced Studies in Planetary Health, the MSP-Brasil, the University of São Paulo, and the University of Rio Grande do Sul.

We can identify distinct lines of action that have developed during this time with teachers of all educational levels, health and community promoters, health and education students, children, and adolescents. Alforja Educativa celebrated its first ten years through sharing knowledge and games primarily throughout Latin America but has grown to motivate people of all ages to reflect about the planet we inhabit, the correlations that exist between all living beings, and the actions we can take to improve and nourish our surroundings.

Children and Adolescent Actions for Health and Life

"The exercise of participation implies the recognition of children as legitimate social agents" —Roger Hart

School Vegetable Garden and the Microbial World

The school vegetable garden is a space for experiential learning, enjoyment, interrelation, and healthy habit acquisition. They developed this proposal with the project, "Our School Vegetable Garden," *Nuestra Horta Escolar* in Spanish, of the Community Health Program, Ministry of the Community, in Formosa, Argentina.

Along with the children, they started a journey of home specimen collection activities to show the ubiquity of microorganisms. They collected samples from their own bodies, the garden, and the benches they sat on. Afterwards, they examined the results with a microscope.

Your Voices are Being Heard: Protecting the Planet's Health

Through the Culture Directorate of the City of Cuenca, cultural managers and librarians from eight cultural centers came together to enact a three-step process with children and adolescents on the subject, "Access to Water and Hand Washing to Prevent Infectious Diseases." The first step was learning about the issue and its relation to both One Health and the microbial world. This was achieved through games, videos, readings, hands-on experiments, and discussions. At the end, the children wrote stories for the project, "Let's Make History by Telling Our Stories".

In this workshop space, adults oversaw the children's creation process. There was a proposal to found the "Forum for Children Protecting our Mother Earth." An organizing committee composed of eight children from Centro Los Eucaliptos planned the meeting, from the thematic axis of climate change, healthy food, exploration of the bacterial world, and

children's participation, to the speakers, guests, and event's agenda.

In Cuenca's Botanical Garden, seventy participants gathered to listen to the children share their experiences, concerns, and proposals. The young people delivered their "Children's Call," a plea to the authorities of the attending institutions to support the voice of youth regarding planetary health.

The process continued with activities, games, readings and preparing natural juices and carrot mayonnaise.

The most successful aspects of this process were the connections and discoveries the children could make and empowerment on the topics they learned, which led them to take part in virtual events such as the UN Global Consultation; we were a part of the meetings held by Latin-American and the Caribbean, the titles of which were, "Health in Community Hands", and "Empowered Communities". In these various arenas, these brave young people took the stage, told their stories, clearly

explained the topics and disseminated their criteria for improving the health of the planet from the perspective of the microbial world.

From the Smallest to the Tiniest Planet: Microbial Storytelling by Children

After conducting an Adventure Cycle with 350 children in Cuenca, Ecuador, the idea to write stories for other children to learn about the microbial world through the words and expressions of their peers developed. Five schools responded to the call, including one intercultural education

school. During a morning workshop, each school presented research on microorganisms and their relationship to food. Afterwards, a group discussion and brainstorming session motivated them to write as a group. Finally, they drew pictures of their stories so that they could illustrate the book. The result was a storybook that was distributed throughout the region and used in workshops, meetings, and readings with children in several countries.

In 2017, they used the storybook as reading material in a series of workshops led by medical and education students from the University of Azuay in twenty local schools. To continue the spirit of child-to-child methodology, students in these workshops wrote their own stories, which later made up the second book of stories.

Educator Education

Another key activity is training teachers, curriculum designers, administrators, and health professionals in the topics and use of Alforja Educativa. Over the years, many in-person meetings with expert speakers have happened in Ecuador, Argentina, Peru, Bolivia, and El Salvador. Various academic institutions and organizations have supported these meetings as co-organizers.

In Cuenca, Ecuador, through an institutional cooperation agreement signed between the Niño a Niño Foundation and the Cuenca Cantonal Health Council, they launched the Health Promoting Schools project. Applying this context, the course “Educators Training in School Health and the Microbial World: Looking after the Health of Humans, Animals, and Ecosystems” was held, with the involvement of representatives from the entire region and with the support of the Medical School from Universidad Nacional de Mar del Plata, Argentina. This course, which lasts about five months, was listed as an official class offering of the Medical School in 2021..

Both virtual and in-person, the goal is broad training with multiple goals. Trainees will be immersed in theory, considering the biocentric

paradigm from a new perspective that recognizes it as an infinite world of interrelationships, and reflect upon the roles of microbes within it. Another key goal centered on ensuring that attendees understand the complexity of bacterial resistance and its relationships to water, nutrition, and health. The participants experience the methodology, activities, games, and dynamics, later reflecting on effective means to engage children in this work. At the end of the courses, the participants develop a project that shows their learning and provides an opportunity for speakers to show how they will incorporate their new knowledge in their workplaces and communities.

Addendum & Further Information

To learn more about the organizations and locations mentioned throughout this text, please utilize the resources below. Organized by chapter as applicable.

Chapter Two

We would like to share some literature that inspired our project. The first is this E-book, only in Portuguese, containing reports and experiences on school gardens from agents in schools and municipal secretaries of environment and education, organized, amongst others, by Beatriz Sinelli and Luís Gustavo Arruda, co-authors of this chapter. At the end of the reports, a state-of-the-art research on school gardens in a Regional Board of Education in the city of São Paulo is also presented.

We also believe that it is important to mention the Brazilian Planetary Health Club for having structured the Education Working Group, in which the materials presented here were conceived. The Club is a group of students, with a horizontal organization, mobilized by the dissemination of planetary health, proposing, amongst others, scientific communication actions - such as podcasts or the live series. For this, one of CBSP's first actions was the elaboration of its definition as a group, with the use of an internal regiment and also from the Brazilian Planetary Health Club Manifesto in a video with subtitles in English and Spanish.

In conclusion, reverberating the search for scientific knowledge on the complex topic of nutrition, we also looked at the Food Guide for the Brazilian population, published in 2014. The Guide, besides providing a detailed classification of foods, also suggests meals and their combinations for a substantial and affordable nutrition for the Brazilian population.

Extensão natural

Website: https://www.extensaonatural.com/

Instagram account: Extensão Natural | Educação para Sustentabilidade (@extensao.natural)

Clube Brasileiro de Saúde Planetária

Website: https://sites.usp.br/cbsp/

Instagram account: Clube Saúde Planetária BR (@clubesaudeplanetariabr)

Clube Sudeste de Saúde Planetária

Instagram account: Clube SE de Saúde Planetária (@clubesudestesaude-planetaria)

Planetary Health Study Group

Website: http://saudeplanetaria.iea.usp.br/pt/

Instagram account: Saúde Planetária (@saudeplanetaria)

Planetary Health Alliance

Website: https://www.planetaryhealthalliance.org/

Instagram account: Planetary Health Alliance (@ph_alliance)

Portal Hortas

Website: https://grupohortasbiousp.wixsite.com/hortas

Instagram account: Hortas na web (@hortasnaweb)

Chapter Three

Learn more about the Planetary Health Alliance's Planetary Health Campus Ambassador Program

Website: Planetary Health Campus Ambassador program

Program at the University of University of São Paulo: Planetary Health Ambassador Program at USP

Video: "The Promise of Planetary Health"

Annex 1: Initial Questionnaire

Part A) Characterization of the group (questions with open answers)

- What is your name?
- What gender do you identify with?
- Do you authorize the use of the information in this questionnaire for research purposes?
- What is your course and current grade?
- What is your educational institution?

- Are you involved in any research projects?
- Have you ever had contact with the concept of planetary health? If yes, what/how was your first contact?
- What are your expectations for the micro-course?

Part B) Conceptions about planetary health (questions with closed answers)

Choose statements consistent with planetary health (scale from 1 to 5 points, where 1 - strongly disagree and 5 - strongly agree):

a) Global climate change implies:

- increased frequency of non-communicable diseases;
- increased frequency of infectious diseases;
- mental health degradation;
- degradation of access to adequate food;
- increased frequency of civil conflicts and territorial displacements;

b) Concerning human relationships with nature...

- The beginning of the Anthropocene period shows that human relationships with nature generate impacts on human health;
- The construction of equity and social justice evidence impacts on human health;
- The construction of movements and systemic change also evidence impacts on human health;
- Systemic and complex thinking evidence impacts on human health;
- Changes in the relationships of human communities with their environments should generate changes in human health;
- Changes in the relationships of human communities with their environments should generate changes in environmental health;

Annex 2: Intermediate Questionnaire

Part A) Characterization of the group (questions with open answers)

Name:

Broad area of research/study:

Specific interests within the broad area (eg, broad area biology, specific interest plant physiology);

Name 3 principles of planetary health directly related to your research/ study:

Part B) Conceptions about planetary health (questions with closed answers)

Choose the statements consistent with planetary health: (multiple responses, where the alternatives were as follows)

- It is a field that studies the impact of humans on ecosystems;
- It identifies the risks that interventions may pose to the survival of humanity itself;
- The growth of the human population and the acceleration of socio-economic activities do not have a great impact on the environment;
- Any professional can contribute to planetary health studies;
- Mental health is the result of epigenetic processes that integrate genetics, society and the environment;
- Diseases such as obesity and malnutrition are related not only to food, but also to climate change;
- The outreach of knowledge acquired by the scientific community is of little importance in the planetary health field;
- Knowing the concepts of planetary health is the responsibility of scientific researchers only;
- Current urban design must be concerned with extremes of heat and smog;
- Planetary health understands human health as intrinsically linked to the health of the environment;

Part C) Reflections on the course (open-ended question)

Criticism, doubts, comments?

Annex 3: Final Questionnaire

Part A) Conceptions about planetary health (questions with closed answers)

Choose statements consistent with planetary health (scale from 1 to 5 points, where 1 - strongly disagree and 5 - strongly agree):

c) Global climate change implies:

- increased frequency of non-communicable diseases;
- increased frequency of infectious diseases;
- mental health degradation;
- degradation of access to adequate food;
- increased frequency of civil conflicts and territorial displacements;

d) Concerning human relationships with nature...

- The beginning of the Anthropocene period shows that human relationships with nature generate impacts on human health;
- The construction of equity and social justice evidence impacts on human health;
- The construction of movements and systemic change also evidence impacts on human health;
- Systemic and complex thinking evidence impacts on human health;
- Changes in the relationships of human communities with their environments should generate changes in human health;
- Changes in the relationships of human communities with their environments should generate changes in environmental health;

Part B) Reflections on the course (open-ended question)

Were your expectations with the micro-course fulfilled? Feel free to give direct feedback on this activity!

Criticism, doubts, comments?

Chapter Four

The *Ecossistemas Costeiros* Project has an active Instagram account called @ecosteiros.ibusp, where they regularly publish updates, activities and content of interest. It is to be pointed out that the posts are in Portuguese, but it is possible to use the automatic translation tool embedded into Instagram.

Some publications in Portuguese describe and discuss the Project's activities. The articles, "*Educommunication as a tool for Environmental Education: Ecossistemas Costeiros Project*" (Melo *et al.*, 2018) and "*Edu-*

cation in Nature" program as a support for elementary and high school education (Berchez; Gattas, Novaes; 2020) present a brief history of the Project and analyze the interface between Environmental Education and Educommunication with a focus on the *Global Climate Change Track*.

In 2021, the work Conservation Units to promote Education and Well-being of students from public schools from São Paulo State, Brazil (Berchez *et al*., 2021) was presented during the Planetary Health Annual Meeting. The presentation focused on the network between Conservation Units, University and public schools established by the Project and the results obtained, both in terms of the public service and the benefits generated for the students.

Finally, although the main current activity of the Project is the *Global Climate Change Trail,* carried out on land, its general aim is teaching in natural areas. In this way, we highlight the production of one member of the Project and author of this article, Luís Gustavo Arruda, the video lesson with a booklet for teachers, Teaching at Sea, which can be accessed through the following website: https://www.extensaonatural.com/post/ensino-de-temáticas-ambientais-em-áreas-naturais.

Chapter Six

Sustentarea UFG shares information, recipes, articles and events in our social media account: *Sustentarea UFG*'s Instagram account: @sustentareaufg

Chapter Eight

Discover more about *Sustentarea UFG* through the following link: https://linktr.ee/sustentarea_ufg

Chapter Ten

Online Tribuna of Bahia news report "Sensors will quantify air pollution in Ilha de Maré and RMS"

FIOCRUZ website: https://portal.fiocruz.br/
BAHIA.jornal's website news report "Ilha dos Frades receives sensors to monitor air quality"
Planet&Ar Project's Instagram account: Planet&Ar (@planet_ar.oficial)

Chapter Twelve

Related material that might be of interest includes DTI public resources, available on DTI's website, which are organized by grade and discipline and include units produced in previous institute programs; this includes the units produced by the cohort that took part in activities with the Sucusari community.

To learn more about the conservation status of the Amazon and its cultures, we suggest the aforementioned documentary, *Guardians of the Forest*, which focuses on the fight of the Maijuna in defense of their ancestral lands. You can learn more about Indigenous peoples in Peru in the book, *Ancestral Lands Of The Ese'Eja: The True People* (2017), or in the film, *Rivers of Gold* (2021). These projects detail the Ese'Eja's struggle and resistance to the harm caused by gold mining.

Organizations, foundations, and documents mentioned:

ACEER's Ethics Policy commitment
Alliance for a Sustainable Amazon
Amazon Explorama Lodges
Amazon Conservatory for Tropical Studies
Foldscope and their Online community
The Longwood Foundation
Morpho Institute
National Geographic Society and their Explorer Mindset Framework
Stroud Center

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