

## GLOBE VSS Research Proposal Template

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**Project Title:**

Environmental monitoring of the Pericumã River using the GLOBE hydrosphere protocol

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## Research Question(s) and Hypothesis

**Research Questions**

1. How do monthly water quality monitoring campaigns, conducted by trained students using GLOBE protocols, reveal spatial and temporal patterns in the physical-chemical parameters (pH, dissolved oxygen, nitrate, conductivity, salinity) of the Pericumã River in Pinheiro/MA?
2. To what extent does the process of data collection, preliminary analysis, and community presentation enhance students' scientific literacy, environmental awareness, and sense of civic engagement?
3. How effectively can the collected data and final report be used to inform and influence local public policies related to sanitation and water resource management?

**Hypotheses**

1. **H1:** The data collected through systematic monthly campaigns will identify specific points along the Pericumã River with parameters that consistently deviate from recommended levels for aquatic health, indicating potential sources of contamination.
  2. **H2:** Students who participate in the full cycle of the project (collection, analysis, discussion, and dissemination) will show a significant increase in their understanding of hydrological science and a stronger sense of responsibility toward local environmental issues compared to their baseline.
  3. **H3:** The final report containing analyzed data and concrete recommendations will be recognized by local authorities as a valid and useful tool for guiding future sanitation and environmental conservation policies in the municipality.
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## Description of Study Site

This study was conducted near the Pericumã River, in a municipality within the Baixada Maranhense Environmental Protection Area, in the Amazon region of Maranhão. Located in the Baixada Maranhense Microregion, the municipality covers an area of 1,513 km<sup>2</sup> within the state of Maranhão, which has 331,983 km<sup>2</sup>, and is 119 km from the capital, São Luís. According to IBGE (2021), it has an estimated population of 84,160 inhabitants and a population density of 51.67 inhabitants per km<sup>2</sup>.

The region's climate is predominantly hot, with temperatures ranging between 23 °C and 36 °C, due to its location in the equatorial zone, and is characterized by two periods: rainy and dry. The region has an extensive drainage network, including several river basins, such as the Mearim, Gurupi, Itapecuru, Grajaú, Turiaçu, Munim, Maracaçumé-Tromaí, Uru-Pericumã-Aurá, Parnaíba-Balsas and Tocantins rivers, being almost entirely located within the Parnaíba Sedimentary Basin, one of the most important hydrogeological provinces in the country (PINHEIRO, 2022).

The waters of the Pericumã River are used for supply, fishing and transportation by the riverside population (CATANHEDE, 2018), and are therefore of great social and environmental importance.

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## Data Collection Plan

### A. Data Types and Sources

- Primary Environmental Data: Physical-chemical parameters of water (pH, dissolved oxygen, nitrate, electrical conductivity, salinity) collected from predefined points along the Rio Pericumã.
- Source: Field measurements taken by student teams during monthly campaigns.
- Process Data: Field sheets, digital database entries, quality control review logs.
- Outcome Data: Preliminary and final analysis reports, community presentation materials, feedback from public authorities.

### B. Data Collection Schedule

- Preparation (Mar-Jun 2026): Selection of collection points, team organization, practical training on GLOBE protocols.
- Execution (Jul - Sep 2026): Monthly water sampling campaigns. Concurrent preliminary data analysis and preparation of partial reports.
- Final Analysis & Dissemination (Oct-Dec 2026): Detailed data analysis with collaborators, preparation of final report with recommendations, presentation of results to the community and local authorities, digital dissemination.

### C. Equipment and Tools

- GLOBE Hydrology Kits or equivalent field equipment for measuring pH, dissolved oxygen, nitrates, conductivity, and salinity.
- GPS for georeferencing collection points.
- Digital and physical field sheets for data recording.
- Database software (e.g., spreadsheet) and data visualization tools (graphs, thematic maps).

- Tools for community dissemination: presentation software, materials for pamphlets, digital platforms.

#### **D. Who Will Collect the Data?**

- Primary Collectors: Teams of students, organized and supervised by teachers/mentors.
- Coordination and Supervision: Project mentors (professors) and collaborating scientists, who will oversee protocol adherence, review data, and guide the analysis.
- Quality Control: A review and verification step will be performed by the supervising team after each collection campaign.

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### **Background and Supporting Information**

#### **Scientific and Contextual Background:**

Access to clean water is a fundamental human right and a critical determinant of public health, ecosystem stability, and socioeconomic development. In Brazil, despite abundant freshwater resources, many regions face significant challenges with water quality due to pollution from inadequate sanitation, agricultural runoff, and urban waste. The state of Maranhão, with its complex network of rivers and estuaries, is particularly vulnerable. The Pericumã River, located in the Baixada Maranhense Environmental Protection Area, is a vital water body for the municipality of Pinheiro, supporting local livelihoods, agriculture, and biodiversity. However, it is subject to increasing pressures from population growth, land use changes, and potential contamination, necessitating regular scientific assessment to monitor its health and inform conservation strategies.

- **Why this topic?** The project addresses the direct need to monitor the water quality of the Pericumã River, a vital resource for Pinheiro, using a scientifically rigorous

and educational approach. It transforms students into active citizen scientists, providing valuable local data while enhancing STEM education.

- **Related Studies/Research:** The project is grounded in the methodologies of the international **GLOBE Program** (NASA). It aligns with Brazilian educational frameworks like the **BNCC** and principles of **Environmental Education** (e.g., Genebaldo Freire Dias). It supports the UN's **Sustainable Development Goals (SDG 6 - Clean Water and Sanitation and SDG 4 - Quality Education)**.
- **Community Relevance:** The project is critically relevant to Pinheiro as it:
  1. Generates a localized dataset on river health, filling an information gap.
  2. Empowers youth through hands-on science, fostering environmental stewardship.
  3. Aims to directly inform public policy, creating a bridge between academic work and tangible community action in sanitation and environmental management.

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## Expected Outcomes or Goals

### General Goal

To collect and analyze environmental data from the Pericumã River, promoting the active participation of high school students and contributing to environmental awareness and the development of public sanitation policies.

### Specific Goals

1. Select and train students for environmental data collection;
  2. Conduct data collection campaigns throughout the year;
  3. Analyze and disseminate the collected data to the community and local authorities.
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