water mineralization and observation of karst processes

water sustainability

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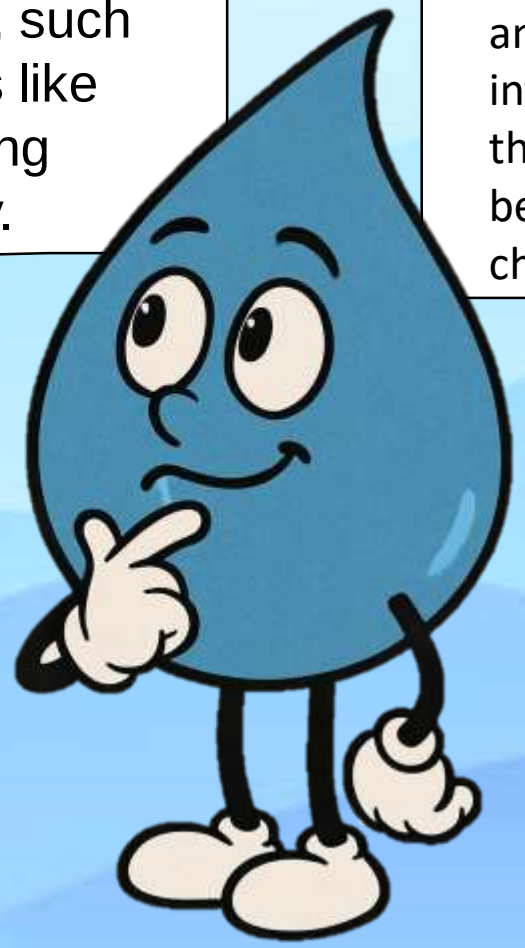
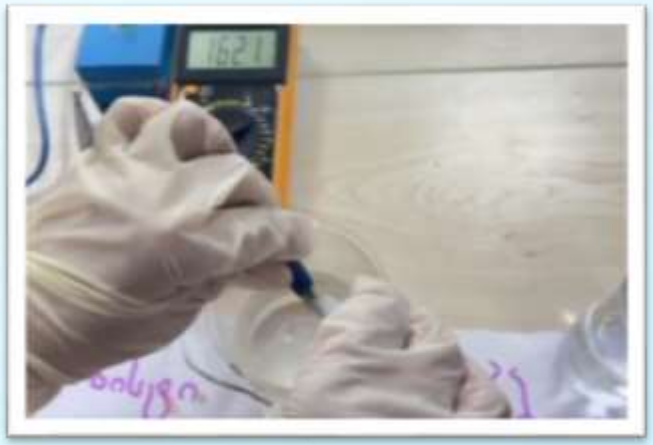
Our project addresses the negative impact of water hardness on human health and everyday life, specifically focusing on the biological and geochemical role of calcium and magnesium. We selected this topic because it allows students to connect complex environmental processes, such as the formation of karst structures like stalactites, with practical engineering solutions using Arduino technology.



This is a real-world concern because water mineralization levels directly affect the functioning of human bone tissue, where an imbalance can lead to harmful medical conditions. Furthermore, monitoring environmental parameters like CO_2 and temperature is vital for maintaining the biogeochemical correctness of natural cave systems and ensuring environmental safety. By creating integrated detection systems, students can model these critical processes in a laboratory setting to better understand water quality and climate-related changes.

Our Investigation: What We Learned & Discovered

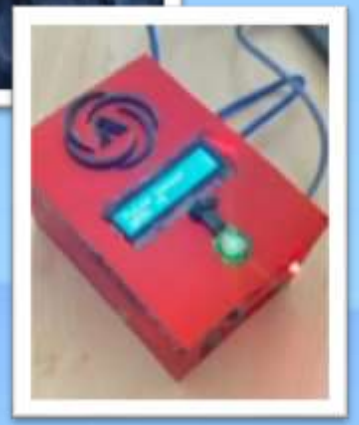


Invisible Minerals: We used soap tests to prove that "clear" water isn't empty. We discovered how high calcium and magnesium levels in mineral water directly impact chemical reactions.

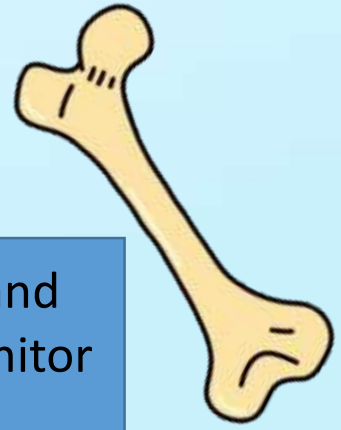
Nature in the Lab: We didn't want to wait a thousand years to see a stalactite form, so we modeled the process using salt crystallization. It showed us exactly how dissolved minerals turn into solid rock.

Building the Tool: We moved from "guessing" to "measuring" by building our own TDS meter with **Arduino**. Coding the sensors taught us how to turn raw electrical signals into real-world data (ppm).

The Big Picture: This project proved that we can use affordable tech (like Arduino) to monitor local water safety and understand complex geological changes in our own community.



Solution Concept & Actions Taken

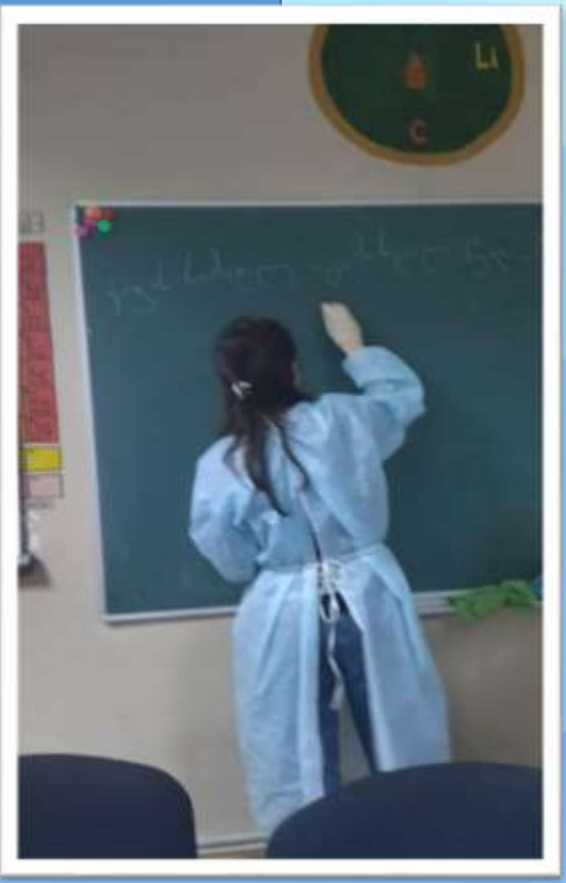


The Concept: Our solution bridges **IoT Engineering** and **Environmental Science**. We designed a system to monitor how water mineralization, temperature, and CO_2 levels interact to shape karst formations and affect water quality.

Action – Field Data Collection: Our team has already started sampling local mineral springs and tap water. We are building a **mineralization database** to track the "chemical fingerprint" of our community's water resources.

Action – Lab Simulation: We launched a **stalactite growth experiment** to model geological processes. This allows us to visualize how dissolved ions crystallize into solid structures, making slow natural phenomena visible in the lab.

Action – Hardware Prototyping: We built a custom **Arduino-based TDS Meter** from scratch. By coding our own sensors and LCD interface, we turned a classroom project into a portable, digital tool for real-time mineral analysis.



Creative Technology Use: We are integrating our sensor data into **digital visualizations**. This helps us demonstrate how environmental fluctuations directly impact geological stability and local ecosystems.