



INSPIRING PRACTICES |  FINALIST 2023 |  URUGUAY

## #ENVIRONMENT

# Young students discover how to clean beaches infected with cyanobacteria

With scientific research and field work with local allies, the students managed to systematize the use of filters to collect the organisms.

### TEACHER

Victoria Calcaterra

### COMMUNITY/CITY

Carmelo

### STEM AREAS

Science and Technology

### STUDENTS

José Banchemo  
Renata Suárez  
Romina Membredes

### SCHOOL

Liceo Miguel Banchemo Noain

### OTHER AREAS OF KNOWLEDGE INVOLVED

Environment

### PROJECT NAME

Cianobacterias

“Cyanobacteria” may seem strange to many people, but they are part of life in Carmelo, a city on the banks of the Río de la Plata, in western Uruguay. Also called blue or cyanophycean algae, cyanobacteria are microorganisms that grow very quickly in the summer and form a large green spot that dominates aquatic environments like a plague. But there is a solution: to filter them with a simple device, made from a variety of common materials. The discovery made by a group of students was one of the finalists in the 10th edition of Solve for Tomorrow in Argentina, Paraguay and Uruguay.

In contact with the skin, cyanobacteria can cause irritation and this harms tourism and the city’s economy. “Carmelo is a city surrounded by water and it is common in summer not to be able to bathe due to cyanobacteria. The students thought about the difficulties that this entails and wanted to change that reality,” says teacher Victoria Calcaterra, who [mediated](#) the project, titled “Cianobacterias”(Cyanobacteria, in english).

The young people involved with the topic were in the sixth year of high school (the last year of compulsory schooling) at the high school Liceo Miguel Banchemo Noain. In Uruguay, this degree

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includes a subject called Economic and Social Studies, characterized by [project-based learning](#). “Throughout the year we sometimes have up to 70 projects simultaneously, thus many ideas arise and we develop them,” explains the educator, responsible for this subject.



Contamination by cyanobacteria on Carmelo beach is notable and causes impacts on health and the economy

For the three teens from “Cianobacterias”, one of the kickstarts was a lecture at the school about the matter, with a group from the Faculty of Sciences of Uruguay. Taking this into account, the students made an empathy map and defined the “persona”, which is the representation of the “ideal customer” of a project or company. That is a resource used to better understand the needs of the final customer. “That person could be anyone in the city, since this problem impacts everyone in some way,” points out the teacher.

## Putting research into practice

Then, the first step was to engage in in-depth research on cyanobacteria: why they appear, what their properties are and how they could be removed from the water. But putting the ideas into practice was a path full of challenges. Not always when they went to collect the organisms they were there. “There were about 20 items of conditions that had to be met for the appearance of

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cyanobacteria. For this project, we focused on four: temperature, humidity, what had to do with water currents and times of year,” she reports.

At times when conditions were favorable and these organisms were seen, they had difficulty filtering them from the water. “They looked for various alternatives as references: from the hemodialysis mechanism that filters the blood to the resources used in the countryside to make water drinkable,” she describes.

In the end, they used three types of filters. The first was the thickest and was made with a mosquito net material. The second used gauze similar to that used in dialysis. The last one was smaller, a manual pool cleaning device was used. “We reduced the quantity because we knew more or less the size of a cyanobacteria and how to filter it,” she adds. The team was careful not to filter fish or other species along with the bacteria.



## Eureka moment!

Although the group considered already tested bibliographic references on cyanobacteria, they had to learn in practice how important it is for projects to adapt and revise initial ideas based on new conditions. Here, the original idea was to make a robust filter to occupy a large beach area, but this would require a more complex structure, such as an engine. “We changed to a smaller filter, a [prototype](#) that can be expanded later,” says the teacher.

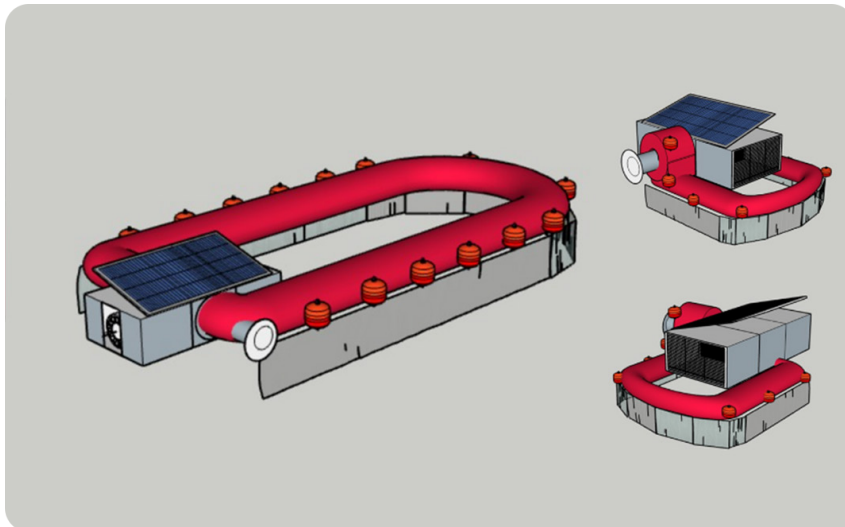


**“It was very positive to see how they transformed in the process. They gained resilience in the face of challenges and even those who were very shy and had never participated in something like this, in the end had a different attitude. The families were also very grateful,”**

says the educator.

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They tested the cleaning system and designed the prototype in a digital version, which can now be made by anyone, through 3D printing. The filtering device can be connected to an Arduino board that detects when there is a possible cyanobacteria bloom. In these cases, the float is deflated and, thanks to a motor, it is rolled towards the collection area.



The digital model of the device, seen from three angles

Another very important moment for the team was the trip to Buenos Aires, for the Solve for Tomorrow awards ceremony. “We had a remarkable experience because of the contact with other people, seeing the research they did, the resources they used,” she recalls.



The group traveled from Carmelo, Uruguay, to Buenos Aires, Argentina, for the Solve for Tomorrow award ceremony. In the picture, they are with the CEO, at the time, of Samsung Argentina

## Collaboration to advance

For the team, [collaboration](#) with allies was essential. They had the support of the school's Chemistry teacher, who guided them on the filtration mechanisms and the chemical properties of cyanobacteria. In addition, the Biology teacher helped to select the necessary materials. The Escuela Técnica de Reparaciones, Construcciones Navales y Anexos (Technical School of Repairs, Naval Constructions and Annexes), made available a pH meter to detect water conditions. Furthermore, the state department responsible for drinking water supply, Obras Sanitarias del Estado (State Sanitation Works Office), indicated the best places to collect cyanobacteria in the city.

The project is now available to the public authorities as a basis for the development of a larger mechanism that can be used in the city. "The students will continue to the university but they left the project so that at the school and the Faculty of Chemistry, other people could access the materials and continue working with cyanobacteria if they want," tells the teacher. Together with researchers from the Faculty of Sciences, the team still sees a future possibility of producing biofuels with these organisms.





## Explaining!

In all the projects in which she mediates, teacher Victoria Calcaterra encourages that there should always be some student in a role that she considers crucial: Human Resources. It is responsible for contacting potential allies and making the connections the team needs. In “Cyanobacteria”, Romina took charge of this position. It was her who first contacted the state department responsible for drinking water supply and discussed the loan of the pH meter with the Technical School of Repairs, Naval Construction and Annexes, for example.



## Focus on practice!

Take a look to the teacher’s guide on how to develop cyanobacteria filters:



### Empathy

After a talk at school about cyanobacteria, the students made an empathy map and defined the “persona”, which is the representation of the “ideal client” of a project or company. That is a resource used to better understand the needs of the final customer. In conclusion, they perceived that this person could be anyone in the city since the problem impacts everyone in some way.




### Definition

Then, the first step was to engage in in-depth research on cyanobacteria: why they appear, what their properties are, and how they could be removed from the water. They decided the parameters on which they were going to focus: temperature, humidity, water currents and times of year. In parallel, they defined the roles of each student: Renata Suárez was the editor, José Banchemo the designer and Romina Membredes the head of Human Resources.




## Ideation

 To develop the project, they had to overcome challenges such as the availability of cyanobacteria and how to collect them. The students looked for various references, from the hemodialysis mechanism that filters blood to the resources used in the field to make water drinkable.




## Prototype

 In addition, they changed the original idea of creating a very large device to occupy the length of a beach and thought of a Minimum Viable Product. In the end, they used three types of filters. The first was the thickest and was made with a mosquito net material. The second used gauze similar to that used in dialysis. The last one was smaller, a manual pool cleaning device was used.



## Testing

 The tests were essential for defining sizes and systematizing the design of the prototype in digital version, which can now be produced by anyone via 3D printing. The filtering device can be connected to an Arduino board that detects when there is a possible cyanobacteria bloom. In these cases, the float is deflated and, thanks to a motor, it is rolled towards the collection area.