

INSPIRING PRACTICE |  WINNER |  ARGENTINA, 2021

#HEALTH

Young Argentines develop a device to capture microplastics

Supported by a teacher, the innovation filters waste that is toxic to human health released by washing clothes

TEACHER

Walter Acosta

SCHOOL

Escuela de Educación Secundaria
Técnica (EEST) N°1 "Crucero A.R.A.
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STEM AREAS

Science, Engineering

OTHER AREAS OF KNOWLEDGE

Languages

PROJECT'S NAME

Kartic Biofilters

The most diverse synthetic fibers (most derived from plastic compounds) have become a common material in contemporary clothing. Whether to achieve colors and textures or to reduce the cost of clothing, what few know is that these fibers end up releasing microplastics when washed; and these microscopic structures end up contaminating waters, which are used for planting and human consumption. Exceedingly small, up to 5mm in diameter, microplastics take between 400 and 1000 years to disintegrate, and when they reach living beings, they lodge in their bodies and tissues, with harmful effects on health, although still little known.

This was one of the topics discussed in an online seminar open to the community held by Universidad del Sur, during the Covid-19 pandemic. When invited by chemistry teacher Walter Acosta to attend the activity, and observe how academic discussion activities are conducted, students Karla Bustamante, Agustín Mangüello, and Victoria Wesner decided that they needed to collaborate on the issue. Students of teacher Walter in the technical degree in chemistry at the Escuela de Educación Secundaria Técnica (EEST) N°1 "Crucero A.R.A. General Belgrano", from the city of Bahía Blanca, 650 km away from the capital, in Argentina, the students decided to advance in a scientific project capable of offering some kind of answer to the challenge.

Although he was familiar with Project-Based Learning concepts, Walter had little practical experience in mediating student authorship activities. But when he was invited, he not only immersed himself in the experience but also profoundly transformed his teaching practices based on it. "My students taught me a lot with this activity. My practice was very content-oriented and this experience showed me the power of the approach via projects, design thinking, and STEM to transform the classroom," he celebrates.

All were conducted as extracurricular activities, at times after the activities, there were many months of dedication by the whole group. To start the proposal, using WhatsApp groups, the teacher and the trio of students shared reference texts on the topic. As a task, after a deadline, the students had to read and summarize the contents discussed in brief meetings during recess or after classes. "It is necessary to remember that they conducted the entire project at the same time as they fulfilled the workload and activities of 12 subjects", argues Walter.

Mobilized by the literature, students began to build hypotheses about the consequences of microplastics on the environment and people. Since particles have already been found in the bloodstream of people and even in the placentas of pregnant women, students wondered what the possible long-term consequences of contamination in the human body would be: microplastics could impact the filtering functions of the human body, such as kidneys and liver? What are the possible consequences? Is there a particle limit to avoid more serious problems? "Our idea was for them to ask good questions, and outline hypotheses, even if they were not able to test or demonstrate them at this moment. And that's exactly what STEM's proposal is! Make students open their minds," explains the teacher.

Once they reasoned that about 35% of microplastics found in water sources, plants, and animals came from washing clothes, the students decided that they needed to develop a kind of filter; low-cost and reusable, for washing machines.

Before defining the filtering compound, the students needed to build the apparatus that would hold it, allowing water to flow and "capture" the plastic microstructures. There were many drawings on paper, reviews of similar existing mechanisms, and projects in design software until reaching the prototype. To design the instrument in 3D, the students used Tinkercad, a free web application that allows the development of 3D projects, electronics, and coding. "As undergraduates in chemistry, they were not used to using tools from digital technologies; and they surprised me a lot, both with the speed with which they learned to use the application and with the quality and complexity of the design they developed," explains the teacher. The printed prototype has a connection for the water inlet of the washing machine's drain hose, and an outlet in its lower part. Detachable, the instrument can be reused in multiple washes and has sealing structures, preventing the possible loss of materials.

Focus on research: the importance of experimentation

As chemistry students, supervised by Walter, the group began to develop laboratory tests to test filter compounds, following the reference literature. After a series of experiments, they arrived at the use of activated charcoal as the best available option. Activated carbon has a very porous structure with a negative electrical charge, capable of attracting toxins and chemicals, such as microplastics. There were several experiments, which required, in addition to carrying them out, careful study and group discussion of the results. The students tested the compounds and their efficiency both in reducing sulfates and in the adhesion and reduction of microplastics in the water.

[Learn more](#)

Access the teacher's report in the Project Gallery.

With the support of the mentorship of Samsung Solve for Tomorrow, students were able to advance in the systematic understanding of their invention for society. "It wasn't just a product they were developing, but a response to a concrete environmental challenge, which profoundly impacts people's lives," explains Walter, calling attention to the importance of the empathic stage of the Project Track. "By actually experiencing the stage, the students took the issue as their own, wanting to solve it, embracing it," he adds.



Eureka Moment!

Walter points out that among the project's challenges, the choice of activated carbon as a filter element was certainly the most important. "They tested and evaluated a series of compounds. We evaluated chitosan [polysaccharide derived from chitin found in crustaceans], but we were unable to find it in abundance. We discussed the use of orange peels, but its management would not be possible on the necessary scale. When we finally conceived and produced an activated carbon gum, and saw that it worked, we realized that we had responded to the challenge," he celebrates.

For the teacher, the mentoring support was also important to dynamize the group's relationships, even training themselves as a mediator teacher. "As hard as I tried, I realized that the students in the classroom didn't feel listened to as they did in activities like this one. I saw that the program's mentor, Clara de Marcos, [coordinator of social and environmental innovation projects at Tekuoia, partner Solve for Tomorrow technique in the country] recognized the voice they had, encouraged them to see themselves, to perceive themselves as leaders, proponents of change," he explains. He also emphasizes the importance of soft skills, especially collaboration. "They had to learn to work together, to recognize each other's strengths, and that they needed support," he argues.

Although informal, monitoring the students gave Walter ideas to start an evaluation process, creating rubrics to monitor the knowledge acquired through learning through projects and the skills and attitudes they develop during the process. "I built markers, which I have been using in regular classes and, at the end of the process, my students started to fill in a questionnaire, identifying what they learned, what are the facilities and challenges of this type of proposal, what they need to improve, what I need to improve as a teacher, etc", he explains, indicating that, he believes this is the way to advance in the quality and relevance of educational processes for youth.

Changes that last

The Solve for Tomorrow proposal started to be applied in the school's graduation projects. Mobilized and engaged with the initiative, the trio left a legacy for the other students and an important part of the teachers, bringing learning through projects and STEM practice as guiding and organizing proposals for these final projects. "Our education focuses on memorizing content, but what will this change the lives of our students? Knowledge gains meaning when it is built by students, when they can apply it, based on their ideas, with creativity," argues Walter, who started to devise short-term projects together with students to address different curricular topics.



Focus on practice!

Take a lot at the teacher's guidance on how to support students in developing a device to filter microplastics released in washing machines.



Empathy



Walter draws attention to the aspect of empathy, encouraging students to recognize themselves in the problem to be studied and eventually faced, both through a literature review and in dialogue with the community, encouraging students to share their impressions and build a collective experience of reflection and discussion on the subject.



Definition



To advance in the definition of the problem, the teacher bets on the fundamental axis of the scientific method: the construction of hypotheses, seeking that from questions, students can advance in propositions and conjectures on the subject, even if they are not able to demonstrate them.



Ideation



As support for ideation, Walter recommends both that students draw and create mockups of their ideas, as well as make use of digital tools available for free and that support the technological planning necessary for the construction of the prototype.



Prototype



In the case of Kartic, the teacher recalls that they are two prototypes in one: the device itself and the filtering material. For the former, he recommends 3D printing, which makes it possible to materialize the group's idea; and for filters, it indicates the importance of experimentation and controlled laboratory testing.



Test



The teacher indicates that it is important to agree and build with students the learning expected from the process, both concerning the science components worked on, as well as the lived experiences and attitudes and skills developed. It indicates moments of dialogue and, when possible, the application of questionnaires that evaluate the proposal as a whole.