



INSPIRING PRACTICE |  WINNER |  BRAZIL, 2020

#ENVIRONMENT

Youth club and a Biodigester at school: teaching in support of the role of young scientists

Young people put into practice biology and chemistry lessons to transform leftover food from the cafeteria into biogas

TEACHER

Bárbara Daniela Guedes Rodrigues
✉ barbaraquimica40@gmail.com

SCHOOL

Escola Estadual Professor
Sebastião de Oliveira Rocha

STEM AREAS

Science

OTHER AREAS OF KNOWLEDGE

Geography

PROJECT'S NAME

Sustainable School Technology
Connected to the Arduino (TESLA)

“You have to believe that it is possible.” This is the mantra that Bárbara Rodrigues, a chemistry teacher at Escola Estadual Professor Sebastião de Oliveira Rocha, in São Carlos (SP), repeats to herself. She believes that the transformation of education lies in encouraging students to think critically and have the space and conditions to build their own responses to local problems. “The science curriculum needs to be lived in practice, answering questions they identify in everyday life,” she explains.

Mediating a Youth Science Club called Tecnologia Escolar Sustentável Ligada ao Arduíno (Sustainable School Technology Connected to the Arduino – TESLA), and with the support of the biology teacher Isabel Cristina Santana Kakuda, Bárbara encouraged a group of ten students to build an anaerobic digester at school. Inspired by another school project, which calculated the waste in school lunches, the young people and the teacher decided to advance the discussion about food leftovers and its effects on the environment. Even having managed to significantly reduce the rates of food disposal, there were still leftovers that could be reused and transformed. “Together, we studied several alternatives for reuse and arrived at the proposal to build a biodigester”, explains Bárbara.

For the construction of the equipment, it was necessary to study concepts of chemistry and biology linked to the decomposition of organic matter and to research conceptual and technical paths to respond to the identified demand. For this purpose the teacher presented a set of academic and didactic references to the class, inviting them to draw their hypotheses. In a dynamic that included meeting moments, individual and collective study of the class, Bárbara drew up a research and experimentation plan with the young people until arriving at the construction of the prototype.



Explaining!

Youth clubs are a pedagogical strategy of the Full-Time Teaching Program of São Paulo State Department of Education, in Brazil. Students enrolled in extended journeys have access to other curricular dynamics, including moments for building and monitoring a Life Project.

In clubs, young people meet in thematic interest groups and, together with the board of directors, choose and invite a teacher to accompany their activities. With a fixed workload for the development of activities, clubs must organize a plan of what they want and how they want to build or access a certain knowledge, sharing the results achieved with the school community at the end of the semester or school year.

Collaborative work: the importance of listening and respect in the collective construction of projects

Impacted by the Covid-19 pandemic, the meetings were initially online but based on the student's needs, they were able to use the school's laboratory for research and empirical tests. "These meeting moments were fundamental not only for the development of the project but also for strengthening our unity as a group", emphasizing the importance of building affective bonds in the teaching and learning process.

The construction of the prototype required a lot of creativity from those involved and constant problem-solving. According to the teacher, replicating something with easily accessible materials at school is not trivial: it was necessary to study and test several alternatives to make the equipment work — from the position where the container [gallon] should be, to the correct sealing of the construction seams. "Many times we almost gave up, but the bond we had and the desire we shared to achieve what we wanted, made us reach the result", she identifies.

Learn more

Access the teacher's report in the Project Gallery.



Eureka moment!

"We were having a hard time measuring the gas production in the project, then I pictured my pilates ball and started to smile with Joy. I ran to my colleague, Isabel and, afterward, we went to meet the class. We celebrated together! The idea could work. The next day, my pilates ball was installed in the biodigester, and in a few days, it was full. Yes! We were producing gas!"

Therefore, according to the teacher, the diversity of the group is fundamental and requires the teacher's attention to the socio-emotional skills of young people, understanding that collaboration between different profiles is necessary for the accomplishment of the work. For her a successful team brings together and stimulates each student profile (the dreamer, the systematizer, the resilient, the maker, etc.) in a process in which everyone has a role and learns to work together, in collaboration. "In the same way, my work with my teaching partner was fundamental. We have different and complementary profiles. I am very anxious; I need to solve everything on time. And Isabel organizes, establishes the steps to get where we want", she justifies.



Focus on the practice!

Take a look at the teacher's guidelines on how to encourage and guide students in building an automatic irrigation system for crops.



Empathize

 Teacher Bárbara reiterates the importance of students having access to a set of training materials to study the issue: academic articles, textbooks, didactic and paradidactic books, ensuring time for the group to discuss and debate the issues found both on the environmental consequences of not treating leftover material organic matter, such as the harmful effects of atmospheric pollution, such as the greenhouse effect, for example, and the decomposition process of organic matter, including the role of fungi and bacteria in food degradation, the emission and behavior of gas, enthalpy and the main chemical reactions that take place during the process, such as combustion and production and release of methane and carbon dioxide to the atmosphere and soil.



Define

 With a well-developed literature review, Bárbara explains the importance of students formulating the research question together and designing a plan (even if initial) of what they will collectively and individually do to answer it.



Ideate

 With plans in place and divisions of tasks agreed upon, it's time to start experimenting. For students to effectively understand the process, it is interesting to invite them to create their biodigester models, with simple and everyday laboratory equipment. It is interesting to encourage the class to raise hypotheses about the process of decomposition of organic materials from their previous conceptions. Thinking collectively about the challenges to be faced is a fundamental part of the process!



Prototype

 Once the class is ready, it's time to build the equipment, which may require several encounters. A simple biodigester consists of a large container, such as a gallon of water for storing organic matter, hoses or pipes and valves for connection, and a sturdy repository for collecting the produced gas, such as a balloon, tire tube, or plastic ball and materials to seal the outlets. To prepare the "trap", responsible for capturing carbon dioxide and hydrogen sulfide from biodigestion, after reading references and laboratory tests, students and teachers chose to use a wall water filter support covered with a 20% calcium hydroxide solution.



Test

 Bárbara emphasizes that creating a diary for project notes, mistakes, and learning is a fundamental practice for the development of the project, as well as the team's learning progression. To support the registration and systematization of activities, inspired by the mentoring of Solve for Tomorrow, the group started to use the free and collaborative tool Trello. Used for project management, the application is easy to use and allowed everyone in the group to keep track of tasks and assignments and to keep records of activities up to date. At the end of the process, Bárbara, the students and the teachers involved, discussed together the learning developed, what was achieved with the project, and the next steps, leaving a legacy in the school not only of the solution found but of the importance of the Science Club to debate local issues.

Materials used

(Base list of materials used in making of the prototype)

- Universal Indicator;
- Potassium hydroxide;
- Calcium hydroxide;
- 50 and 100 ml beaker;
- 10mL graduated pipette;
- PHmeter with buffer solution (4, 7, and 10) for calibration;
- Magnetic stirrer with magnetic bar;
- P.A. hydrochloric acid;
- Water distiller;
- Analytical balance;
- Spatula;
- Glass rod;
- Tags;
- 50mL disposable syringe;
- 250ml Kitasatos;
- Pissettes;
- Homemade gas meter;
- 20L plastic bucket;
- Silicone hose;
- Laboratory notebook;
- 2 200L plastic pumps;
- 4 ½ inch flanges;
- 5 ½ inch logs;
- 4 threads (nipple) of ¾ inch;
- 4 ½ inch extruder adapter;
- 2m of ¾-inch hoses;
- 4 adjustable clamps of ½ x 5/8;
- 1 oil funnel;
- 1 7.5 cm accordion tube;
- 1 large silicone tube;
- 1 large PU sealant tube;
- 2 black spray tubes;
- 1 pilates ball;
- Bovine manure;
- Arduino kit.