MODULE V

Lesson Plan 2

Summary

Title	
Mini Hydraulic Generator	
Duration	60 minutes
Age range	10-14

Abstract

In this didactic session, students aged 10-14 will design and build a model of a hydroelectric generator. Through this hands-on experience, they will learn the basic principles of hydropower and its conversion into electrical energy.

The activity will start with a theoretical introduction, briefly presenting the importance of renewable energies and explaining the functioning of hydropower plants. This section will address the water cycle and energy conversion, providing a conceptual basis for the students.

The students will then build their model step by step, following the instructions and using the recyclable materials provided. They will assemble the turbine, generator, and system that simulates water flow. This stage will reinforce the concepts learned during the theoretical introduction.

Once the models have been built, the students will conduct tests to ensure they are working correctly. During this phase, they will make any necessary adjustments to improve the generator's efficiency. This testing and adjustment process will allow students to experience and better understand the technical challenges associated with power generation.

Finally, the activity will conclude with a group analysis and reflection session. Students will present the results obtained and explore possible improvements to their designs. They will also reflect on the impact of hydropower on the environment and society, promoting a deeper understanding of the benefits and challenges of renewable energy.

Learning results

Aim of the project / Learning objectives

- Raise awareness of the importance of energy efficiency based on renewable energies and sustainability for the care of the environment.
- Understand the importance of recycling for waste reduction.
- Analyse and understand the operation of a hydroelectric generator (transformation of hydraulic energy into electrical energy).

Transversal objectives

- Encourage creativity and teamwork.
- Raise awareness of the importance of caring for the environment.
- Develop effective communication skills, both oral and written.

Sustainable Development Goals Connection

This topic is aligned with SDG 7, "Ensure access to affordable, secure, sustainable and modern energy." Goal 7.2 By 2030, the share of renewable energy in the energy mix will be significantly increased.

Implementation

Facilitation

- Prepare the resources for the activity in advance for its correct development.
- Separate the classroom tables into groups in advance.
- Ensure that all materials used are recycled.
- Tin the LED wires to the DC motor.
- Drill a hole in 1 bottle cap.

Resources / Materials needed

- 1 DC motor
- 4 strips of cardboard 25x3 cm.
- 2 strips of cardboard 15x3 cm.
- 1 cardboard square the size of the DC motor.
- 1 plastic bottle
- 7 bottle caps.
- Cutter
- Scissors
- 1 straw
- 1 LED light
- Tin
- Silicone gun and silicone tube.
- Instant glue.
- 1 wooden depressor.
- Water

Ideas to continue

- Hydroelectric Generator Design Optimisation: Investigate and implement design improvements to increase efficiency and power generation capacity.
- Comparison with other renewable energy sources: building a wind generator model and comparing its efficiency and operation with the hydroelectric generator.
- Environmental Impact Analysis: Research and present real case studies on the environmental impact of hydropower plants.
- IT integration: develop a monitoring system using sensors and an IoT (Internet of Things) platform to measure variables such as water flow and energy production.
- Social Impact: Study and propose solutions to bring renewable energy to remote communities or communities with limited access to electricity.

Source / Classroom materials and preparation
A detailed explanation of how to create the model: https://www.youtube.com/watch?v=75Eqjpck3Po&ab_channel=ProyectosCasero Another similar project: https://www.youtube.com/watch?v=1LdssEyOyb4

Topic outline

Time	Step-by-step instructions
5 min.	Preparation of groups in the classroom.
10 min	Brief theoretical introduction to hydropower, its importance in the global energy matrix, and its environmental benefits. Explanation of the activity.
5 min.	Cut the bottle in half with the cutter (See Annex 2 / Figure 5.2.1). Make a hole in the center of the bottle cap with the scissors (See Annex 2 / Figure 5.2.2).
5 min.	Cut the straw to a quarter of its length (See Annex 2 / Figure 5.2.3). Put the straw into the central hole of the bottle stopper and glue it with silicone (See Annex 2 / Figure 5.2.4). Put the stopper on the bottle.
5 min.	Glue two of the longer strips of cardboard to the sides of the bottle (See Annex 2 / Figure 5.2.5). Use the other two long strips as a base, glueing the end of the glued strips to the bottle with silicone (See Annex 2 / Figure 5.2.6). Glue the shorter cardboard strips crosswise to the others to complete the square base of the mini hydro generator (See Annex 2 / Figure 5.2.7).
10 min.	With the bottle caps, we will make the propeller. We will use the one that has already been drilled in the centre and glue the rest sideways with silicone (See Annex 2 / Figure 5.2.8). Insert the DC motor in the hole of the central plug and glue it with instant glue (See Annex 2 / Figure 5.2.9).
5 min.	Glue the cardboard square to the back of the motor with silicone. Glue this base laterally to one of the cardboard strips that are standing upright (See Annex 2 / Figure 5.2.10).
10 min.	Cut the depressor in half and glue it behind the base of the engine and the foot strip as a fastener (see Annex 2 / Figure 5.2.11). Glue the straw to the corner of the generator base with silicone (See Annex 2 / Figure 5.2.12). Glue the LED to the top of the straw (See Annex 2 / Figure 5.2.13).
5 min.	Pour water into the top of the bottle and check that the generator is working (See Annex 2 / Figure 5.2.14).

Formative evaluation

- Observe the interest and participation of each student in the classroom.
- Ask questions orally to check group and individual learning.
- Carry out digital questionnaires with the Kahoot platform.

Feedback

Net Promoter Score (NPS) is a widely used tool to measure the loyalty and satisfaction of customers or, in an educational context, students. It measures the likelihood that students will recommend the subject or course to others.
How to analyse and apply NPS is explained below:

Development of the NPS question:

- Main question: "On a scale of 0 to 10, how likely are you to recommend this topic to other students?
- Follow-up questions: "Why did you select this score?" and "How can we improve this issue?

Collection of responses:

- Digital surveys: Online tools such as Google Forms, SurveyMonkey, or Typeform can be used to collect student responses.
- Paper surveys: At the end of the lesson, paper questionnaires are distributed for students to complete. The Annex shows a template for collecting responses with paper surveys.
- Interactive applications: Interactive applications such as Quizziz, Mentimeter, or Kahoot! are used to collect real-time answers.

Classification of responses:

- Promoters (Score 9-10): Students are very satisfied and likely to recommend the subject.
- Passive (score 7-8): Satisfied but not enthusiastic students; they could easily change their minds.
- Detractors (Score 0-6): Dissatisfied students who are unlikely to recommend the subject; they could provide constructive criticism.

Calculation of NPS:

- Formula: NPS = % of promoters - % of detractors.
- Score interpretation: NPS ranges from -100 to +100. A positive score (above 0) is generally good, and a score above 50 is excellent.

Analysing and using comments:

- Review the comments to understand the reasons behind the scores.
- Identifies patterns and specific areas for improvement among detractors and passives.
- Use the promoters' positive comments to reinforce the positive aspects of the issue.

Annexes

ANNEX 1:

QUESTIONNAIRE TO COLLECT FEEDBACK ON THE TOPIC

On a scale of 0 to 10, how likely would you recommend this subject to other students?

0	1	2	3	4	5	6	7	8	9	10

Not likely at all — Extremely likely

Why did you choose that score?

How could this issue be improved?

ANNEX 2:

In this Annex, the Figures representing the development of the proposed activity are shown.



Figure 5.2.1 Cutting the bottle. Link: https://www.youtube.com/watch?v=75Eqjpck3Po&ab_channel=ProyectosCasero



Figure 5.2.2 Making a hole in the centre of the bottle cap. Link: https://www.youtube.com/watch?v=75Eqjpck3Po&ab_channel=ProyectosCasero



Figure 5.2.3 Cutting the straw to a quarter of its length. Link: https://www.youtube.com/watch?v=75Eqjpck3Po&ab_channel=ProyectosCasero



Figure 5.2.4 Putting the straw into the central hole of the bottle stopper and glueing it with silicone. Link: https://www.youtube.com/watch?v=75Eqjpck3Po&ab_channel=ProyectosCasero



Figure 5.2.5 Gluing two of the longer strips of cardboard to the sides of the bottle. Link: https://www.youtube.com/watch?v=75Eqjpck3Po&ab_channel=ProyectosCasero

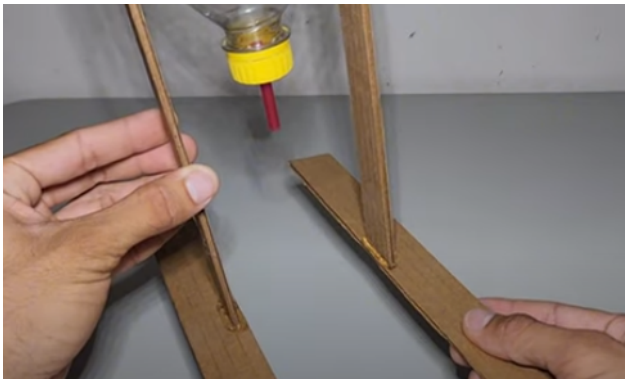


Figure 5.2.6 Using the other two long strips as a base, glue the end of the glued strips to the bottle with silicone. Link: https://www.youtube.com/watch?v=75Eqjpck3Po&ab_channel=ProyectosCasero

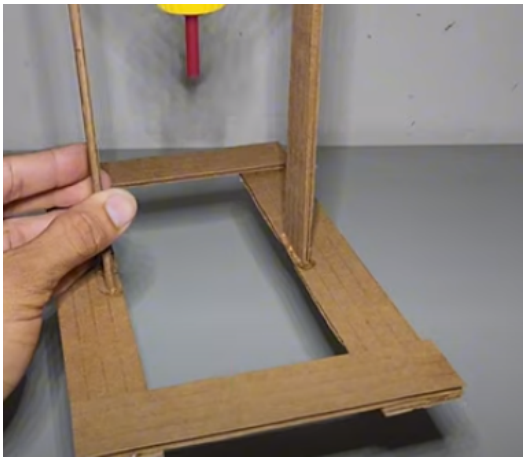


Figure 5.2.7 Gluing the shorter cardboard strips crosswise to the others to complete the square base of the mini hydro generator. Link: https://www.youtube.com/watch?v=75Eqjpck3Po&ab_channel=ProyectosCasero

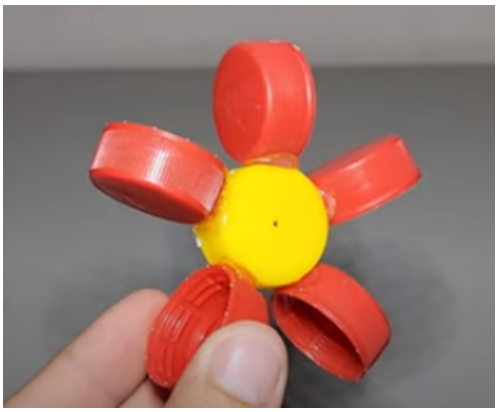


Figure 5.2.8 Assembling the propeller with the bottle caps. Link: https://www.youtube.com/watch?v=75Eqjpck3Po&ab_channel=ProyectosCasero



Figure 5.2.9 Gluing the DC motor in the hole of the central plug. Link: https://www.youtube.com/watch?v=75Eqjpck3Po&ab_channel=ProyectosCasero

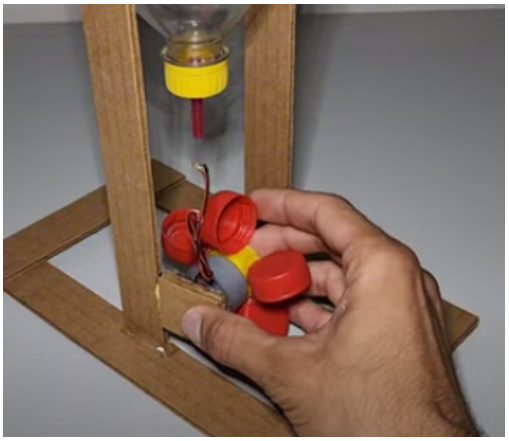


Figure 5.2.10 Gluing the cardboard square to the back of the motor with silicone. Then, glue the resulting base laterally to one of the cardboard strips. Link: https://www.youtube.com/watch?v=75Eqjpck3Po&ab_channel=ProyectosCasero

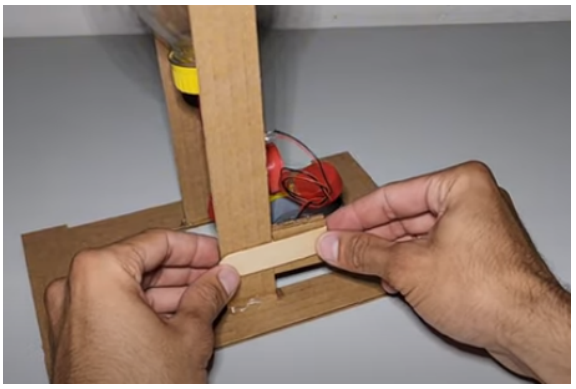


Figure 5.2.11 Gluing the depressor behind the engine's base and the foot strip as a fastener. Link: https://www.youtube.com/watch?v=75Eqjpck3Po&ab_channel=ProyectosCasero

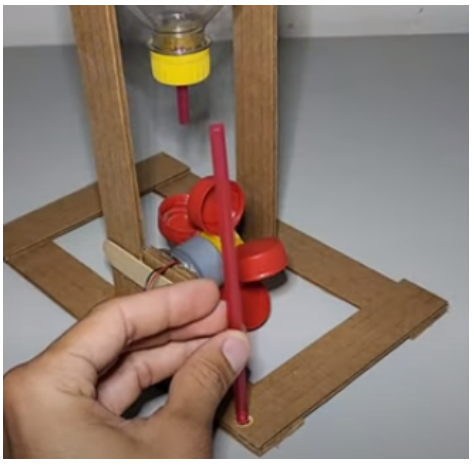


Figure 5.2.12 Gluing the straw to the corner of the generator base with silicone. Link: https://www.youtube.com/watch?v=75Eqjpck3Po&ab_channel=ProyectosCasero

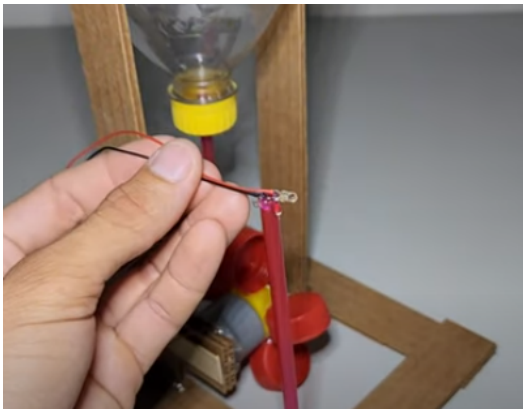


Figure 5.2.13 Gluing the LED to the top of the straw. Link: https://www.youtube.com/watch?v=75Eqjpck3Po&ab_channel=ProyectosCasero



Figure 5.2.14 Pouring water into the top of the bottle and checking that the generator is working. Link: https://www.youtube.com/watch?v=75Eqjpck3Po&ab_channel=ProyectosCasero