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LEARNING & CREATIVITY PLAN (L&C PLAN): A "SMART" VILLAGE ON THE MOUNTAIN SLOPE

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1. Overview

Title	**A "smart" village on the mountain slope!**
Driving Question or Topic	*Utilizing the dam of the area for the production of electricity and the supply of a settlement with electricity, throughout the year. How feasible is this project?*
Ages, Grades, …	*12-15* *K-9*
Duration, Timeline, Activities	*16* *4*45 min + 6*90 min* *7 activities*
Curriculum Alignment	*Types of mechanical energy. Gravitational dynamic energy. Power. Electric energy. Pump and electric generator operation. Dimensions-volume / capacity of 3D shapes. Inductive reasoning / generalization.*
Contributors, Partners	
Abstract - Synopsis	*The students study the possibility of utilizing the dam located in the area where a settlement of 800 inhabitants is built, to cover the needs of the settlement in electricity. They calculate the amount of electricity consumed by the inhabitants of the settlement, to determine the amount of water from the dam that will be used. Then they build a model for raising the amount of water in a tank located at a certain height with the help of photovoltaics. Students explore the dimensions that the tank should have, for a specific required amount of water, given the limitation regarding the perimeter of the base of the tank to be constructed. They cost the project for supplying the settlement with electricity and calculate the time it will take to recoup the costs of such a solution.*
References, Acknowledgements	

2. STEAME Framework*

Teachers' Cooperation	• **Teacher 1 (T1) - Teacher of Design and Technology** Teaching the basic principles of operation of photovoltaics, pump and electric generator. Construction of a model with lifting water from one container to another located higher with the use of photovoltaics and utilization of water for electricity production. Coordination of groups. Technology Laboratory. • **Teacher 2 (T2) - Teacher of Physics** Teaching the concepts of dynamic energy and power. Experiment of calculating the power and the electrical energy consumed in an electrical circuit and the useful power. Study of the model constructed in the Technology course Physics Laboratory. • **Teacher 3 (T3) - Teacher of Mathematics** Investigation of the dimensions of a rectangular parallelepiped and a cylinder in relation to the volume and area of their base. The aim is to discover the

	dimensions of the solids that give maximum base area for a given fixed base perimeter and are selected at a specific height to achieve the given solid volume. **• Teacher 4 (T4) – Teacher of Economics (or Mathematics, if there is no Teacher of Economics in school)** Economic research for the electrification of a city at night with the use of photovoltaics to raise the amount of water during the day to a level and utilization of its dynamic energy for electricity production at night.
STEAME in Life (SiL) Organization	Efforts to harness solar energy and other renewable energy sources for detoxification from fossil fuels are a constant concern for society.
Action Plan Formulation	**STAGE I:** Preparation by T1 and T2 [STEPS 1-3], and **STAGE II:** Formulation of an Action Plan [Preparation of STEPS 1-2] by the teachers. **STAGE II:** Formulation of an Action Plan [Implementation of STEPS 3-11]… The support, feedback and evaluation by the teachers is present during the implementation of the activities and not only the final result. **STAGE II:** Formulation of an Action Plan [Implementation of STEPS 3-11]… Refers to the realization by the students of the activities of the Learning Plan. **STAGE II:** Formulation of results by students and guidance by teachers (STEPS 12-14). Intermediate control by teachers and feedback to students (STEP 15) **STAGE II:** Repeat steps 5 - 11, if necessary, draw final conclusions and communicate them (STEPS 16 - 18).

3. Objectives and Methodologies

Learning Goals and Objectives	1. Design and perform experimental activities to calculate the power delivered to an electrical circuit from an electrical source. 2. To design and construct models for the simulation of a phenomenon or a process. 3. Collect and record data using various methods, such as observation, measurement / recording 4. To investigate relationships between the dimensions of prisms and their volume or the area of their base. 5. Conduct market research, process financial data and draw conclusions about the viability of a project.
Learning Outcomes and expected Results	1. Experimental data on the power consumed in a circuit. 2. Construction - model for storage of solar energy by lifting water. 3. Economic study for the viability of such a project
Prior Knowledge and Prerequisites	Basic knowledge of electricity (Ohm's law, construction of an electrical circuit, use of ammeter and voltmeter, the concept of power and the calculation of energy consumed in an electrical circuit). Identification of prism characteristics, application of flat shape finding types and prism volume. Construction of a graph with ordered pairs.
Motivation, Methodology, Strategies, Scaffolds	Inquiry approach, individual work and group work.

4. Preparation and Means

Preparation, Space Setting, *Troubleshooting Tips*	The teaching of the basic concepts of Physics for electrical circuits, electrical power and mechanical energy items and the experimental activities for measuring the electrical power consumed in a circuit will be implemented by T1 in the Physics laboratory. The teaching of the operation of photovoltaics, pump and electric generator will be done by T1 in the Technology laboratory. The support of the students for the investigation that they will do for the cost of the project will be done by the T3 in collaboration with the T1 and T2.
Resources, Tools, Material, Attachments, Equipment	• Materials for the construction of an electrical circuit and measurements from the Physics laboratory. • Materials for the construction of the model are supplied by T1 from the Technology laboratory. • The mathematical investigation will take place in the Mathematics' course. • Data on the consumption of electricity by the population of a city can be obtained from the Electricity Company of the area.
Safety and Health	Safety measures observed in Physics and design and technology laboratories

5. Implementation

Instructional Activities, Procedures, Reflections	**Activity 1: Teamwork** The topographic plan of a small village located near a dam (or river or natural or artificial lake) on a hillside is shown and students are asked to think and record ways to turn this settlement into a "smart village". They can search for relevant information on the internet to determine what "smart village" (or "smart city") means. The ideas they will propose should be based on and utilize the location of the village and the surrounding area. The group proposals are presented and discussed. **Activity 2: Working with the whole class** The following key question of the project is presented, which will be addressed by the students: "How will the dam of the area and the solar energy be used to produce electricity for the needs of the settlement?". Ways of collecting solar energy in the settlement, ways of converting solar energy into electricity throughout the year and how the water of the dam can be utilized in this project are discussed. The stages of the work and the individual elements and steps included in each stage are mentioned and recorded. It is reported that the water from the tank returns to the lake through an electric generator, producing electricity, which is used to supply electricity to the settlement. **Activity 3: Electricity consumption** The students estimate the electricity consumed by a house and then calculate based on this estimate, the total amount of electricity consumed by the settlement of 800 inhabitants. If the students are not familiar with the concepts of power and energy consumed in a circuit, then they perform the following experimental activity: In the Physics laboratory, the teams build an electrical circuit with an electrical source, a resistor (lamp), an ammeter switch and a voltmeter. They make the necessary measurements and calculate the power supplied to the circuit by the electrical source and the electricity consumed in the circuit at a given time. **Activity 4: Construction of a model for raising the amount of water (group work)**

	The students design a model for lifting water from the dam to a tank located at a certain height. Photovoltaics are used to raise the water during the day with sunshine. The number of photovoltaics that will be required to complete this activity is obtained through research done by students on the internet with reference to their power. The teams investigate the energy efficiency of their construction, measuring the electrical power produced by their model and comparing it in proportion to the power provided by the photovoltaic they have chosen from the market as the most suitable. **Activity 5: Tank dimensions** Given that the tank will be placed at a height of 200 m above the dam, students calculate the amount of water that should be stored in it, based on the dynamic energy that the water will have at this height and efficiency of generators. Next, the students explore the dimensions that a tank with a capacity of 4500m3 of water should have, since the total volume of water required is 45000 m3 and 10 identical tanks will be constructed. The shape of the tank should be a rectangular parallelepiped with a base perimeter of 120 m and at the same time it should cover the maximum ground surface. Fill in a table with the dimensions of the tank (Worksheet X) and make a graph of the area of the tank base and the length of its base. They investigate when the base of the tank has a maximum area for the given perimeter of 120m and generalize. They discuss their conclusions in plenary. The investigation can be expanded by inviting students to make corresponding calculations if the shape of the tank is cylindrical. **Activity 6: Economic study of the electricity supply of the settlement based on the model that was constructed** Each group of students develops an action plan for the financial study of the electricity supply of the settlement based on the data they have studied and collected in the previous activities. They investigate the total cost of the project, the time required to amortize the costs and present concerns and arguments as to whether this project is sustainable. **Activity 7: Presentation of works** Each group presents its measurements, constructions and financial study. The work of all the groups is discussed and in the plenary the final rubric of the evaluation of the whole action is agreed.
Assessment - Evaluation	The feedback and evaluation is continuous and continuous throughout the actions until the presentation of the results. In addition, students evaluate their own work based on the discussion during the presentation phase of their work.
Presentation - Reporting - Sharing	Presentation in the plenary of the department and in the school magazine. Exhibition of models made in a suitable place in the school.
Extensions - Other Information	Depending on the results of the research, the research can be modified to explore the possibility of applying the idea on a smaller scale to the needs of an area of the city. The role of the geomorphology of the area and how much it supports such a solution for electrification can also be explored.