OVERVIEW OF THE LES

« Biogas »

Target audience:	2nd year of the 2nd cycle in Science of the Environment and Science and Technology of the Environment
Team or individual work:	Individual and in teams of two
Class time required:	6 - 75 minute periods

Educational Aim

The climate changes that we face today are intimately linked to the increase in greenhouse gases present in the atmosphere. What are these gases? What actions can we take or what technologies should we recommend to slow this problem?

Lead the students to think about the notion of ecological footprint, energy needs and the management of residual matter using the study of the production and energy output of biogases.

Allow the student to become familiar with the relationship between thermal energy, mass, specific heat capacity and temperature in the context of energy production. The student will be led to understand the function of a *bio-digester* to produce methane and evaluate the quantity of thermal energy produced.

NOTE: This LES was designed within the framework of training sessions for personnel in science and technology. It will require adaptation before being used with students.

Targeted disciplinary competencies:

Competency 1 (Seeks answers or solutions to scientific or technological problems) and 3 (Communicates in the languages used in science and technology) are targeted in this LES.

The student must determine experimentally the optimal conditions for producing methane. He must then experimentally evaluate the quantity of thermal energy produced by the gas recovered.

C-1: All the components are mobilised in this situation. The student must consider the context of the situation. He must become familiar with the elements essential to the problem, as much the scientific concepts involved as well as the relationship that governs the exploitation of fossil energy resources and the greenhouse effect. He must grasp the initial data to give himself an adequate representation of the problem to be resolved. He has to imagine a plan of action, target factors to control, put his plan into action, gather the necessary data and compare his results to those of his peers. A preliminary evaluation grid for the competency is suggested in the teacher's guide.

C-3: All the components are mobilised in this situation. Each student will have to interpret scientific messages of various natures. He must select the pertinent information to give himself a representation of the situation. He must produce a laboratory report and consult reports produced by his peers in order to judge his process and his own results.

Targeted cross-curricular competencies: No cross-curricular competency is targeted in this training activity.

Broad Area of Learning	***Environment and consumption*** *Axes of development:* *- Knowledge of the environment* • Consciousness of the interdependence between the environment and human activity; • Knowledge of renewable and non-renewable resources. *- Consciousness of the social, economic and ethical aspects of the world of consumerism* • Knowledge of the origin of various consumer goods; • Mindful of the consequences of globalisation on cultures, ways of life, and of the distribution of wealth; • Mindful of a viable and consistent consumption and of an equitable distribution of resources. *- Construction of a healthy environment within the perspective of sustainable development:* • Knowledge of the repercussions of the presence of a community on the territory that it occupies; • Mindful of the rational use of resources; • Mindful of the integration of environmental values into the production process of goods and services.
Required concepts	**Technological World:** • Biotechnology o Biodegradability of pollutants **Earth and Space:** • Lithosphere o Degradation of soils o Contamination • Hydrosphere o Eutrophisation • Atmosphere o Greenhouse effect **Material World:** • Chemical transformations o Stœchiometry o Endothermic and exothermic reactions • Transformation of energy o Relationship between thermal energy, specific heat capacity, mass and variations in temperature **Living World:** - Ecological footprint
Community resources	- Environmental groups - Chairs, research centers in education related to the environment - Environment Canada's Biosphere - Sustainable development - Kyoto Protocol - Faculties of Science and Engineering - Energy efficiency agency - Development of the electrical network - Environment Canada

Processes	The **experimental process** as well as a part of the **opinion building process** are at the heart of this LES. The student is led to experimentally evaluate the quantity of energy produced from biogas and to build his knowledge through various learning activities. Each of the activities that make up the LES allow him, in varying degrees, to understand the deterioration of residual matter and to make the most of newly acquired as well as previously acquired knowledge in the elaboration of an experimental process.
Strategies, attitudes and techniques	***Exploration strategies:*** - To inventory the greatest amount of scientific, technological and contextual information that may eventually be useful to outline a problem; - Envisage various points of view related to the situational problem. ***Analytical strategies:*** - Determine the constraints and the elements important to the resolution of the problem; - To call upon various methods of reasoning to treat the information. ***Attitude:*** - Interest in confronting ideas - Intellectual rigor - Mindful of precise measurement - Sense of methodical work - Mindful of correct and precise language - Respect for life and the environment - International solidarity regarding the great problems of our time ***Techniques:*** - Safe use of laboratory material - Verification of the reliability, correctness and sensitivity of instruments of measurement - Interpretation of the results of the measurement (significant numbers, measurement related errors).
Possible evaluation: This type of task allows for the evaluation of C-1 and C-3.	
Global context: Residual matters and energy are at the heart of this LES. The student will elaborate an experimental process through which he must calculate the energy created by the combustion of the gases collected.	