Working document

OVERVIEW OF THE TASK

The Stirling engine

Target audience:	2nd cycle of secondary school (5th year) Chemistry
Team work:	2 people
Class time required:	10 - 75 minute periods

Educational Aim:
This learning and evaluation situation will allow the student to understand the scientific and technological principles used in the construction of the Stirling engine. Initially, the student must become familiar with the concepts related to the physical properties of gases. Next, the student will be required to adjust the Stirling engine in order for it to function properly. Finally, the situation places the student in a context of scientific analysis of a technological application in order to become knowledgeable as to the behaviour of gases.

NOTE: This activity was designed within the framework of teacher training sessions. It will require adaptation before being used with students.

Targeted disciplinary competencies:
D_c-2 Makes the most of his knowledge of chemistry (scientific analysis of an application)

This LES touches very well upon the three components of this competency.

- Examine an application (the Stirling engine)
- Understand the principles of chemistry relating to the application (learning activity)
- Explain an application from a chemistry angle (complex task)

D_c-3 Communicate on questions of chemistry using the languages used in science and technology.

Targeted cross-curricular competency:
C_t-2 Solves problems

In the course of this LES, through knowledge acquisition and analysis tasks about the engine, the student will resolve numerous problems.

Broad Area of Learning	**Environment and consumption** Axis of development: knowledge of the environment (knowledge of renewable and non-renewable resources). The Stirling engine offers much flexibility in this regard. The heat necessary to its proper function can come from any source.

Concepts that may be involved	**Gas: Physical properties of gases** • *Kinetic theory of gases* • *General law on gases* • Gaseous molecular volume
Cultural references	The patent for the hot air (Stirling) engine was deposited on September 27th 1816. For competitive reasons, the engine designed by Scotsman Robert Stirling never knew commercial success. It was supplanted in turn by the steam boiler and the internal combustion engine. With an output clearly superior to that of internal combustion engines, however, the Stirling engine surely has a bright future. Indeed, current ecological concerns over energy conservation and biofuels make this engine very interesting, since it can function on any kind of fuel (straw, wood, alcohol, the sun's rays…)

Possible evaluation:

Two descriptive, 5 level evaluation grids are supplied with the task. These grids are particularly aimed at disciplinary competencies 2 and 3.

Global context:

We begin this LES with an historical video presentation dealing with the Stirling engine. The students must then form teams of two and meet to complete the learning activities broaching the concepts necessary to understand the engine. Once these concepts have been mastered, each team will have to make a Stirling engine work. It will be necessary to adjust certain parts to complete this task. Finally, a scientific analysis of the engine will be required. In his written work, the student will have to demonstrate his complete understanding of the engine. As well, a reflection document will be requested.