Activity 1

LE SAUT quantique
CENTRE D'INNOVATION PÉDAGOGIQUE
EN SCIENCES AU COLLÉGIAL

Bring Your Musical Instrument!

Activity developed at Collège Shawinigan
By **SIMON LANGLOIS**

Activity 1

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Scientific Discipline

Physics

Average Age of Students

18-19 years old

Course Title and Number

Optics and Modern Physics (NYC-203-05)

Duration of Activity

4 hours (2 hours per week)

NOTE

In this document, the masculine is used without discrimination and solely to make the text easier to read.

Appendices are available in PDF and Word format on the CD provided with this document.

In addition, an instructional analysis of the activity is available in the pedagogical treasures section (*Trésors pédagogiques*) on the Saut Quantique Web site at: **http://www.apsq.org/sautquantique**.

SAUT QUANTIQUE
LE SAUT
CENTRE D'INNOVATION PÉDAGOGIQUE EN SCIENCES AU COLLÉGIAL

Bring Your Musical Instrument!

This activity aims at familiarizing students with the fundamental principles involved in the production of sounds in musical instruments. It is done in teams of two. Students bring a musical instrument to class, and can compare the laws of open pipes and vibrating strings to reality.

If students are more interested in other aspects, they must submit their study topic to the teacher's attention.

The activity includes three separate parts:

- Presentation of a problem to be solved as part of the laboratory;
- Completion of the laboratory based on a protocol developed by students themselves;
- Presentation of results to the other members of the working group (4-6 students).

RELEVANCE AND ORIGINALITY OF ACTIVITY

Two major points provide a unique character to this activity:

- Students are free to explore the aspect that affects them the most in the study of their musical instrument, which brings a creative approach rarely encountered in physics and science. This is why the laboratory is scheduled for four hours rather than two.
- When the laboratory assignment is complete (after 3 hours), students divide into working groups to present their results. This enables them to develop their critical judgment much more than during a traditional laboratory.

Objectives and Relation to the Program

PEDAGOGICAL OBJECTIVES OR TARGETED COMPETENCIES

Develop student autonomy and creativity.

Link Between the Activity And the Program

GENERAL PROGRAM GOALS TARGETED

This activity targets the great majority of the general goals of the *Science* program. The main ones include:

- To apply the experimental method;
- To take a systematic approach to problem solving;
- To reason logically;
- To communicate effectively;
- To learn autonomously;
- To work as members of a team;
- To adopt attitudes that are useful for scientific work;
- To apply what they have learned to new situations.

Link with Course

This activity is conducted after the first third of the semester that includes the course *Optics* and *Modern Physics*. It is in fact a wrap-up activity for the first part of the course (waves). It includes,

for example, the principle of resonance applied to an open pipe (flute) or string (guitar). The activity allows students to apply the theory of simple harmonic movement (SHM) and waves seen in class and as part of previous laboratories.

Link with Other Courses

Of course, this activity is closely linked with music. It helps students understand the physics principles behind musical instruments. In addition, due to the presence of Fourier components, mathematics are essential to understanding the phenomena at play.

Number of Students and Educational Support

APPROXIMATE NUMBER OF STUDENTS IN CLASS

15-30 students, depending on the size of the groups

NUMBER OF STUDENTS PER TEAM

2 people

EDUCATIONAL SUPPORT

The teacher and technician guide the students in their personal work by answering questions. They must also ensure the feasibility of the laboratory in terms of available materials, design difficulty and time required for completion.

Conducting the Activity

CONDUCTING THE ACTIVITY AND TIME REQUIRED TO COMPLETE EACH STEP

Before

One week before the experiment, students look at the laboratory assignments suggested by their teacher (see Appendix S.1). Based on the texts, they develop a problem that they will present to the teacher before they begin their work. The purpose of this exercise is to guide the students by letting them know whether their problem is feasible or not. (30 minutes)

During

The laboratory, which lasts four hours, is divided into three separate parts:

Students present a problem to the teacher or technician. They then determine which manipulations are required to solve their problem. These reflections are done in teams, using available resources (books, Internet sites, teachers, technicians, other students, etc.). (30 minutes)

Students complete the laboratory assignment according to the protocol that they will have developed based on their problem. (3 hours)

The students present their results to the other members of their working group (4-6 students) and are evaluated by the other teams based on the following criteria: validity, accuracy, reproducibility, etc. (30 minutes, i.e. 10 to 15 minutes per team)

After

Students prepare a laboratory report using conventional standards, but substitute the purpose of the laboratory with a problem.

Evaluation and Required Material

SUGGESTED EVALUATIONS

- Oral presentation (30%);

- Laboratory report (70%).

The evaluation is based on the usual criteria, and should take into consideration the amount of creativity involved in dealing with the problem. Indeed, creativity should be evaluated based, among others, on the means used by students to bypass the problematic situations with which they are confronted.

REQUIRED MATERIAL

Musical instruments provided by the students, microphones, oscilloscopes (actual version or downloadable from the Internet)

APPENDICES

Students

Appendix S.1: Points to Ponder

Note:

Appendices are available in PDF and Word format on the CD provided with this document.

Use of this text is authorized for instructional purposes, provided that author name and college are mentioned.

OTHER IDEAS TO EXPLORE

You can explore Fourier transforms in music (composition in spectrum frequency) and the harmonic contents of vowels pronounced by a person.

MEDIA DIRECTORY

"Son, harmonique et musique", Cégep de Drummondville, experiment in the *Physics* course (203-NYC-05): *Waves, Optics and Modern Physics*.

BENSON, Harris, *Physique: Ondes, optique et physique moderne*, 3rd Edition, Montreal, ERPI.

Relationship between the frequencies of musical notes. [Online]. URL Address: http://www.cegepat.qc.ca/tphysique/sebas/page%20accueil/musique.htm

Analyzing a sound. [Online]. URL Address: http://www.ac-creteil.fr/physique/DOCGRISP/Anason2/anason.htm#1