

TEMPLATE for the TEACHERS



★ **Name of the project:**

Show Me The Music

★ **Subjects covered from STEAM areas:**

Science – Physics (mechanical and EM waves, the principle of superposition, standing waves, the law of light reflection)

Technology – online tone generator

Engineering – Tonoscope and laser pen microphone construction

Art – expressing emotions through colours, photo shooting, singing and playing musical instruments.

Math – laws of physics

★ **Target group (age range and size of the group)**

11-14 - whole class, the first workshop

15-18 – whole class, first and second workshop

★ **Duration of the activity:**

- two workshops in school,
- two evaluation workshops in school (one for evaluating learning objectives and one for evaluation and summarizing results and each phase of the process)
- Each activity lasts 90 minutes. Preparation for each activity lasts 120 minutes.

★ **Keywords:**

Waves, sound, light, frequency, colour, emotions, standing waves, Chladni figures, laser light show

★ **Key sentence describing context of the activity, followed by short description (200 words):**

This task should encourage students to express themselves via sound and light, based on their knowledge of mechanical and EM waves and their applications.

TEMPLATE for the TEACHERS

Students will build a Tonoscope (a mechanical device that produces a visual form of an audible sound) and a laser pen microphone which will be used in workshops.

During the workshops, the presence of various types of waves will be displayed in real life so that students can understand their relationship to the substance.

The project aims to focus on waves but there are so many other elements of learning present which include inquiry-based learning, problem-solving, collaboration, communication, independent learning, and more.

★ Description of the activity environment, including the list of materials and tools needed:

Formal activities are performed in the school, in the classrooms.

First workshop tools and materials needed: large diameter plastic tube, speakerphone, mobile phone, online tone generator, large black plastic trash bag, coloured sand, glue, scissors.

Second workshop tools and materials needed: a plastic jar, a large balloon, a piece of the plastic mirror (1cm x 1cm), laser pen, a wooden slat, glue, scissors.

★ Step by step, detailed description of the activity, including teaching and learning strategies.

- Students engage in a dialogue with the teacher and each other about the application of previously learnt physics concepts.
- Students take part in workshops:

1. First workshop:

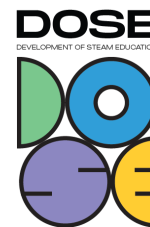
a) Students build a Tonoscope, connect a speakerphone to an online tone generator and place it in a Tonoscope, lay sand on the Tonoscope surface. Vibrations on resonant frequencies create complex figures (Chladni figures).

b) Students will connect the speakerphone with the mobile phone playing music, place it in a Tonoscope, scatter the coloured sand on Tonoscope. Students have the freedom to choose the emotion they want to express, and to choose the associated colour at will. After the tune has ended, the student will take a photo of the Tonoscope surface. A sidenote - an exhibition Student-tune-photo can be made at a later time.

2. Second workshop:

Students build laser pen microphones that can be used for singing or playing musical

TEMPLATE for the TEACHERS



instruments, solo or in a group. Microphones are used to create a laser light show.

★ Learning objectives/competencies:

This workshop describes how to investigate waves with the help of hands-on activities. Described activities can be used for connections between physics and art. The workshops could be implemented in regular school lessons as a project.

The domain-specific objectives are:

The first objective was understanding mechanical waves through the exploration of principles of sound, standing waves, frequency, and the principle of superposition.

The second goal was understanding electromagnetic waves through the exploration of principles of light, colours, the law of refraction, and lasers.

★ Evaluation/Assessment guidelines

Evaluation is done through informal students' feedback and via formal assessment made by the teacher.

★ Lessons learned:

The presence of various types of waves and wave-substance relationship.

★ Additional information/Links:

<https://www.szynalski.com/tone-generator/>

★ Contact person

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