Deliverable 2.3

Modular STEAM educational curriculum

Co-funded by the European Union

Funded by the European Union through the CREATIVE EUROPE Programme. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or European Education and Culture Executive Agency (EACEA). Neither the European Union nor the granting authority can be held responsible for them.

Project n°: 101173445 — CREA-CULT-2024-COOP

Our project partners:

Co-funded by the European Union

Document Control Page

WP/Task	WP2 / T2.4
Title	Modular STEAM educational curriculum
Due date	30/9/2025
Submission date	29/9/2025
Abstract	This document will present the proposed modular educational curriculum to realise the educational activities of the project. It is a guide to teachers (and students) about the modules that they can select to realise STEAM activities in their schools concerning theater, music and maker spaces. The propose curriculum integrate the core principles of STEAM into a cohesive educational experience, with emphasis to be given to the 'arts' education part.
Author(s)	Menelaos Sotiriou (Science View)
Contributor(s)	All Partners
Reviewer(s)	All Partners
Dissemination level	☐ internal ☒ public ☐ confidential

Document Control Page

Version	Date	Modified by	Comments
1	9/7/2025	SV	First draft presenting the structure of the deliverable to discuss it with the partners
2	31/8/2025	SV, NUCLIO, INQUIRIUM, Matera Hub	Input for the respective Modules.
3	15/9/2025	SV	Pre-Final version of the deliverable, integration of partners comments and suggestions.
4	29/9/2025	SV	Final version of the deliverable, integration of partners comments and suggestions.

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Commission. Neither the European Union nor the granting authority can be held responsible for them.

Table of contents

1 Introduction

1.1 STEAM Innovation aims

STEAM Innovation recognizes the unique interconnection of science, heritage, culture, and arts. Within this context, environmental issues can be also addressed, encouraging students to think critically about how they can contribute to sustainable development through their artistic and scientific endeavours and improve their green competence profile. Thus, the project envisages **using the arts as a medium to articulate complex scientific concepts, particularly those relating to environmental stewardship (Chapin et al., 2010) and climate change**. The project will empower participants, especially those from marginalized backgrounds, students with fewer opportunities to learning, and underrepresented groups in the STEM sector, by giving them a platform to express their unique cultural identities and perspectives. This expression through creative STEAM activities will assist in breaking down barriers, challenging stereotypes, and enhancing a sense of belonging and community. Furthermore, the project aims to transform the role of student in the learning process, shifting from passive recipients to active creators of knowledge. Through mentorship and collaboration with professionals across various fields, young learners will gain practical insights and develop solutions that integrate scientific understanding with artistic practice. The STEAM Innovation project aligns with EU priorities and the UN SDGs, focusing primarily on social inclusion, sustainability (i.e., environmental stewardship, and climate action), as well as on digital literacy. This strategic focus on systemic change will stimulate diverse participation and collaboration, endorsing new business models within sustainable cultural heritage and leveraging cultural and environmental assets.

1.2 The rationale of the 'STEAM Innovation' project

Within the conceptual framework of the STEAM Innovation project, the synthesis of artistic practice and scientific inquiry emerges as an innovative approach to education and a contributor to cultural understanding and peace.

The project aims to create an environment where young learners, specifically those in the age groups of upper primary (9-12 years) and secondary (13-18 years) education, immerse themselves in the methodologies of science while simultaneously exploring the rich tapestry of artistic expression. This approach will be enriched by integrating elements of cultural heritage, encouraging a dialogical relationship among these traditionally disparate disciplines. The inclusion of cultural heritage in STEAM learning, has the potential to deepen the learners' understanding and appreciation of their own and others' cultures but also provides a contextual backdrop, enhancing the interconnectedness of science, arts, and human history. This holistic educational model is designed to cultivate critical thinking, creativity, and a profound respect for cultural diversity, equipping students to contribute thoughtfully to the global community.

Specifically, the document presents a pedagogical framework that will lead to an educational program (D2.3) that will facilitate the articulation of scientific phenomena through artistic mediums and methods, such as theatrical dramatization, musical composition, and the development of artistic crafts through making and tinkering processes in Makerspaces. Based on the STEAM Innovation framework, this document, the educational program (D2.3) will be particularly invested in the hands-on production of novel artistic artifacts and artworks by students, which can be showcased within local communities, and transnationally, thereby fostering a tangible connection between the learners' creations and their cultural environment.

music	Students study scientific themes like acoustic ecology and the physics of sound, exploring how environmental changes affect natural soundscapes or the science behind musical instruments of different cultures. This leads to creating musical pieces or sound installations that embody their findings, merging artistic expression with scientific exploration. Students could, for example, compose a piece interpreting climate change data, using elements like tempo and harmony to represent environmental shifts, thus contributing to cultural awareness and the music industry.
theatre	Theatre serves as a storytelling platform, effectively conveying scientific concepts. Students can craft plays that dramatize scientific phenomena or technology's societal impact, incorporating cultural narratives and ethical dilemmas. Through scriptwriting and stagecraft, they deepen their topic understanding while honing skills in communication and creative thinking, potentially influencing the theatre industry with fresh, culturally rich. content.
making & tinkering	In makerspace environments, hands-on learning allows students to use making and tinkering as tools for STEM innovation. Projects might range from building sustainable city models to designing robots for environmental cleanup, often drawing inspiration from cultural heritage and traditional techniques. These activities can bring STEM concepts to life and offer potential prototypes and innovations for creative industries.

2 STEAM Effectiveness and the Need for the STEAM Innovation Modular Curriculum

2.1 The Effectiveness of STEAM Education

Over the past two decades, STEAM education—an integrated approach combining Science, Technology, Engineering, the Arts, and Mathematics—has been recognized as a powerful framework for preparing learners to meet the challenges of a rapidly evolving world. Unlike traditional siloed approaches, STEAM invites students to explore problems and questions through multiple lenses, developing a holistic understanding that links scientific reasoning with creativity, design thinking, and human expression.

Research has consistently shown that STEAM education enhances not only academic achievement but also critical 21st-century skills such as problem solving, collaboration, innovation, and adaptability (OECD, 2019; European Commission, 2020). The inclusion of the arts provides students with opportunities for creativity, communication, and reflection, while also fostering empathy and engagement. By blending rigorous scientific inquiry with artistic practices, STEAM learning environments empower students to make sense of abstract concepts, connect knowledge to lived experiences, and generate innovative solutions to complex, real-world challenges.

Furthermore, evidence indicates that STEAM education plays a vital role in inclusion and motivation. Artistic elements lower barriers for students who may feel less confident in traditional STEM disciplines, offering alternative entry points into scientific learning. At the same time, creative tasks engage students emotionally, strengthening long-term retention of knowledge and encouraging lifelong learning.

2.2 The Need for a Modular STEAM Innovation Curriculum

While the potential of STEAM is widely acknowledged, schools often struggle with practical implementation. Teachers face challenges in aligning STEAM activities with national curricula, ensuring progression across age levels, and balancing creativity with scientific rigor. Moreover, the lack of structured materials, lesson plans, and assessment strategies can make it difficult for educators to systematically integrate STEAM practices into classroom teaching.

The STEAM Innovation project addresses these challenges through the development of a modular curriculum that combines flexibility with structure. The curriculum is organized around a syllabus with three core modules—Learning STEAM Through Theater, Learning STEAM Through Music, and Learning STEAM Through Making and Tinkering. Each module provides multiple pathways for teachers and students to engage with science and the arts, while also supporting cross-disciplinary learning.
The curriculum includes:

- Modules/Syllabus: a clear framework identifying objectives, outcomes, and suggested themes.
- Lesson Plans: ready-to-use guides structured around inquiry-based phases.
- Educational Materials: resources and activities supporting hands-on learning.
- Assessment Tools: strategies to measure scientific understanding, creativity, and collaboration.

2.3 The Added Value of STEAM Innovation

The STEAM Innovation curriculum is not simply about integrating art into science education—it is about rethinking how knowledge is created and shared. By encouraging students to dramatize physics concepts through theater, explore mathematical patterns in music, or design prototypes through tinkering, the curriculum transforms abstract theories into embodied experiences. This kind of learning fosters both intellectual depth and creative expression, preparing students for the complexity of contemporary life.

Moreover, the modular structure responds directly to policy recommendations at both European and international levels, which emphasize the importance of interdisciplinary approaches, creativity, and student-centered learning (OECD, 2021; European Commission, 2022). The curriculum provides concrete tools to operationalize these priorities in classrooms, ensuring that innovation is not only aspirational but also actionable.

The effectiveness of STEAM education is clear: it fosters inquiry, creativity, and collaboration, while also enhancing inclusion and motivation. Yet its full potential can only be realized when educators are equipped with structured, flexible, and evidence-based tools that make implementation feasible. The STEAM Innovation modular curriculum—consisting of a syllabus, lesson plans, educational materials, and assessment tools—responds to this need.

By providing a coherent yet adaptable framework, it enables schools to introduce meaningful STEAM practices that are sustainable and impactful. Most importantly, it empowers students to see themselves not only as learners of science or art, but as innovators who can connect knowledge across disciplines, express ideas creatively, and address the challenges of the future with confidence and imagination.

3 STEAM Innovation Modular Curriculum

3.1 The Modular Approach of the STEAM Innovation Syllabus

The Syllabus is designed to be modular, offering schools and teachers the flexibility to implement one module at a time or combine multiple modules into larger interdisciplinary projects. This modular design ensures adaptability to diverse school contexts, resources, and teacher expertise, while still maintaining coherence and alignment with curricular objectives.

Each module provides a distinct pathway into STEAM learning, offering multiple “entry points” for students with different interests and talents. This ensures inclusion, as learners who may feel less confident in science or mathematics can engage through artistic or practical dimensions, while still developing scientific understanding.

3.2 The Three Modules of the STEAM Innovation Curriculum

Below are presented the main aspects of the 3 Modules. The detailed description of each module, including the lesson plans, the material and all the needed information is presented in ANEXXES.

3.2.1 Learning STEAM Through Theater

This module uses theatrical practices and embodied learning as tools to explore scientific concepts. Students dramatize inquiry questions, develop narratives based on scientific phenomena, and present performances that communicate their findings. Through role-play, improvisation, and performance, they engage deeply with abstract concepts, making them concrete and accessible. Theater supports collaboration, empathy, and communication skills while reinforcing inquiry-based learning. This module refer to both primary and secondary schools.

More specifically:

Objectives

- Engage students in embodied learning by using drama and performance to represent scientific and mathematical concepts.
- Foster creativity, communication, and collaboration.
- Build connections between cultural heritage, social themes, and STEAM subjects.

Methodology

- Use of theatrical forms (role-play, shadow theater, improvisation, storytelling).
- Project-based tasks where students co-create performances to explain scientific principles.
- Inclusion of cultural narratives to enhance contextual learning.

Expected Outcomes

- Clearer understanding of abstract STEAM concepts.
- Enhanced soft skills (teamwork, empathy, public speaking).
- Increased motivation and engagement in learning.

Assessment

- Teacher and peer feedback during rehearsals.
- Evaluation of final performances (clarity, creativity, scientific accuracy).
- Reflective self-assessment on learning outcomes.

3.2.2 Learning STEAM Through Music

This module emphasizes the natural connections between music, mathematics, and science. Rhythm, harmony, and sound provide opportunities to explore patterns, ratios, acoustics, and physical phenomena. By composing, performing, or analyzing music, students uncover scientific principles while also exercising creativity. This approach enhances both logical reasoning and aesthetic appreciation, bridging two seemingly distant domains. In this specific Module the project presents 2 parts. The 1st refers to upper primary schools while the 2nd to high schools.

More specifically:

Objectives

- Explore STEM principles through rhythm, harmony, and sound.
- Strengthen creativity and digital literacy through music-making.
- Promote intercultural understanding via musical traditions and innovations.

Methodology

- Analyzing rhythm and harmony as STEM structures.
- Constructing simple instruments and experimenting with sound waves.
- Using digital tools (apps, coding, software) to create and analyze music.
- Linking scientific concepts such as frequency, vibration, and resonance with artistic expression.

Expected Outcomes

- Ability to connect STEM principles with music.
- Development of original musical projects (performances, digital compositions, instruments).
- Broader cultural appreciation through music and science integration.

Assessment

- Formative: feedback on sound experiments and compositions.
- Summative: presentation of a music-based STEAM project.
- Self-assessment: student reflections on scientific understanding through music.

3.2.3 Learning STEAM Through Making and Tinkering

This hands-on module places design, experimentation, and prototyping at the center of learning. Students explore scientific questions by building models, experimenting with materials, or designing solutions to real-world problems. Making and tinkering emphasize iterative learning, where failure is seen as part of the process, cultivating resilience and problem-solving skills. This approach resonates strongly with engineering and technological innovation, while also fostering creativity and imagination.

More specifically:

Objectives

- Develop innovation and problem-solving skills through hands-on creation.
- Integrate engineering, coding, and design thinking with the arts.
- Encourage curiosity, resilience, and iterative learning.

Methodology

- Tinkering with materials, electronics, and maker tools (3D printing, robotics, recycled materials).
- Collaborative projects where students design, test, and refine solutions.
- Incorporation of sustainability principles and eco-friendly practices.

Expected Outcomes

- Acquisition of technical and creative making skills.
- Strengthened confidence and ownership of learning.
- Production of functional prototypes linking arts and science.

Assessment

- Ongoing feedback on tinkering process and teamwork.
- Evaluation of final prototypes or projects.
- Reflective self-assessment documenting learning journey.

3.2.4 Integration Across Modules

The three modules can be implemented individually or in sequence, depending on school context, teacher expertise, and student needs. When combined, they provide a comprehensive STEAM pathway:

- Theater emphasizes expression and embodiment,
- Music highlights patterns, harmony, and sound,
- Making & Tinkering cultivates invention and problem-solving.

Together, they form a holistic syllabus that empowers students to learn science through creativity, culture, and hands-on experimentation.

3.3 Towards a Holistic STEAM Curriculum

Together, these three modules provide a comprehensive framework that addresses the diverse needs of learners. Schools can implement the modules separately, aligning them with specific subjects or projects, or combine them to create interdisciplinary projects that integrate theater, music, and tinkering into a single holistic learning experience.

The STEAM Innovation Educational Syllabus is more than a collection of activities—it is a structured pathway to:

- Equip teachers with ready-to-use lesson plans, educational materials, and assessment tools.
- Engage students through creative, inclusive, and inquiry-based approaches.
- Foster innovation and creativity as core learning outcomes alongside scientific knowledge.
- Support schools and education systems in meeting international policy goals for interdisciplinary and future-oriented education.

In this way, the syllabus contributes not only to improving teaching and learning practices but also to building a culture of innovation, collaboration, and creativity in European education.

The graphical representation of the proposed Modular STEAM Educational Curriculum is presented in the following Figure 1.

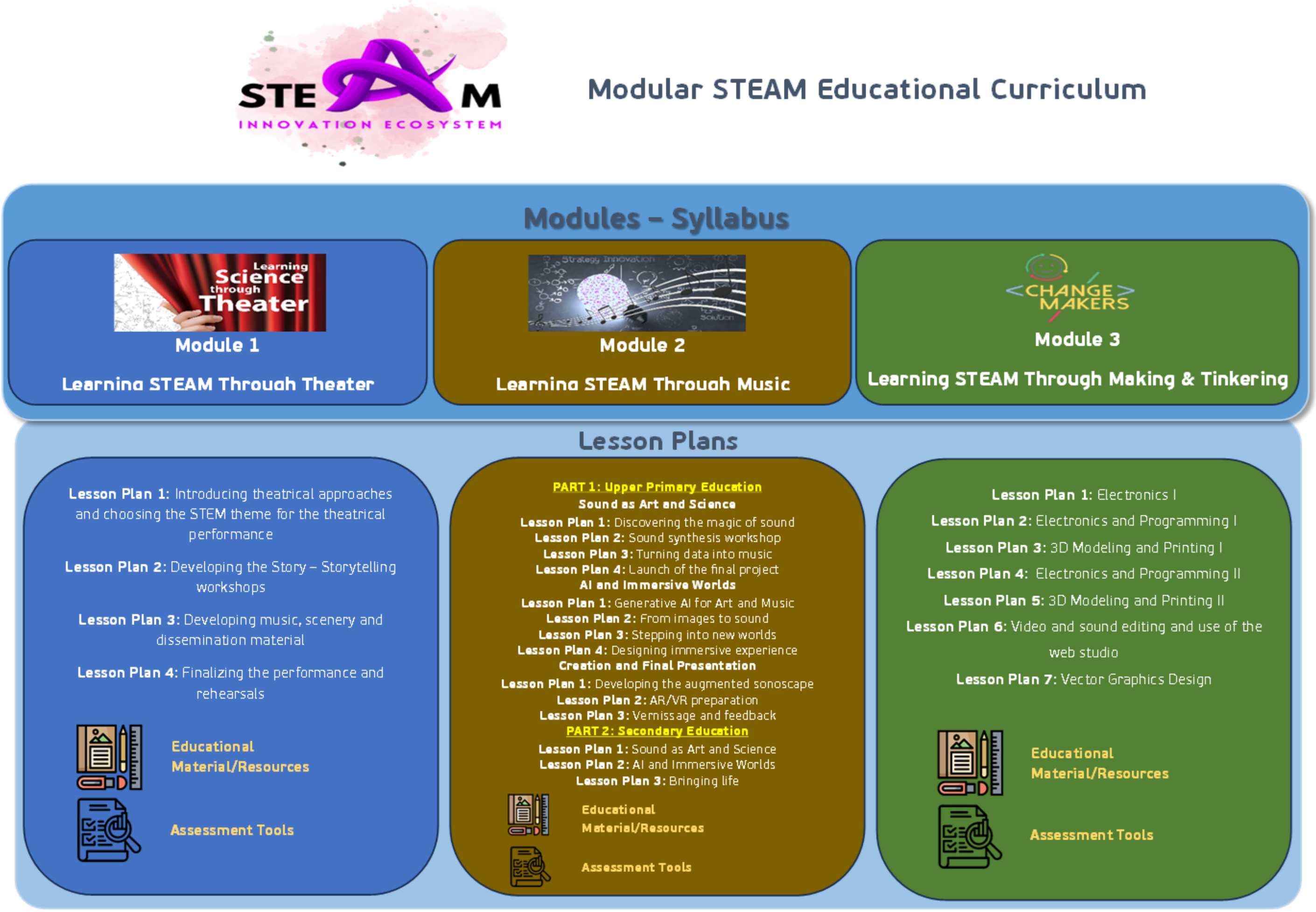


Figure 1: *The Modular STEAM Educational Curriculum of the STEAM Innovation project.*

4 Recommendations for the Realization of the STEAM Innovation Curriculum and Modules

4.1 Implementation as Separate Modules

Each of the three modules—Learning STEAM Through Theater, Learning STEAM Through Music, and Learning STEAM Through Making and Tinkering—are designed to stand independently, offering distinct approaches to integrate arts and sciences in the classroom. Implementing them separately allows teachers to:

- Align with specific curriculum goals (e.g., Theater in literature and physics classes, Music in mathematics and acoustics, Making/Tinkering in engineering or environmental science).
- Adapt to teacher expertise and school resources (schools with strong theater or music traditions can choose the corresponding module first).
- Pilot small-scale innovations, testing one module at a time, evaluating impact, refining practices, and gradually scaling up STEAM integration.

4.2 Integrated and Combined Use of Modules

Beyond individual implementation, the true strength of the STEAM Innovation curriculum lies in its potential for cross-module integration. Teachers and schools can combine lesson plans across modules to create richer, multidimensional learning pathways. For example:

- **Theater + Music:** dramatize scientific processes while incorporating original musical compositions.
- **Theater + Making/Tinkering:** create stage props, models, or installations blending engineering with storytelling.
- **Music + Making/Tinkering:** design and build instruments or sound devices, exploring the science of sound with artistic outcomes.
- **Full Integration:** large-scale interdisciplinary projects combining all three modules (e.g., a science-themed musical performance with student-built instruments and set designs).

4.3 Lesson Plan Combinations

Lesson plans from each module can be sequenced or intertwined according to the inquiry-based phases:

- Sequential Combination: start with Theater to explore a question, continue with Music for deeper pattern exploration, conclude with Making/Tinkering for tangible models.
- Parallel Combination: different groups explore the same theme with different modules, then present outcomes together in exhibitions or performances.
- Spiral Combination: revisit modules across phases (Music in Evidence, Theater in Analyze & Explain, Making/Tinkering in Communication).

4.4 Practical Considerations for Schools

- Teacher Collaboration: encourage cross-departmental planning between science, arts, and technology teachers.

- Flexible Scheduling: implement modules during regular classes, project days, or extracurricular programs.
- Partnerships with Experts: engage artists, musicians, and scientists for authenticity and mentorship.
- Assessment Integration: use tools to measure knowledge, creativity, collaboration, and communication.

4.5 Strategic Recommendations

- Begin with one module as an entry point, then expand to cross-module projects as confidence grows.
- Use modular design to customize learning paths for different age groups, contexts, and resource levels.
- Encourage student choice, allowing learners to select modules or roles (acting, composing, building).
- Promote interdisciplinary showcases, where projects from different modules are presented together for greater visibility and impact.

5 ANEXXES

Module 1

Learning STEAM Through Theater

Co-funded by the European Union

Funded by the European Union through the CREATIVE EUROPE Programme. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or European Education and Culture Executive Agency (EACEA). Neither the European Union nor the granting authority can be held responsible for them.

Project n°: 101173445 — CREA-CULT-2024-COOP

Our project partners:

Author(s): Menelaos Sotiriou

Institution(s): Science View

Date: 21/7/2025

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Commission. Neither the European Union nor the granting authority can be held responsible for them.

Table of contents

1 Introduction

1.1 Purpose of the document

The *Learning STEAM Through Theater* (based on the Learning Science Through Theater initiative - https://lstt.eu/) module is designed to immerse students in scientific inquiry through the creative power of theatrical expression. Its purpose is to bridge the gap between scientific concepts and human experience, enabling learners to investigate complex phenomena not only with their minds but also with their bodies, emotions, and imagination. By combining inquiry-based learning with theatrical techniques, the module transforms abstract knowledge into tangible, embodied understanding.

Through a structured process that mirrors the phases of scientific inquiry—posing questions, collecting evidence, analyzing information, explaining results, and communicating findings—students engage in active exploration while simultaneously developing artistic and collaborative skills. Warm-up games, improvisation, role-play, and performance creation allow students to dramatize their learning, encouraging them to think critically, ask new questions, and reflect on their discoveries.

The module also emphasizes interdisciplinarity, inviting connections between science and the arts, and fostering teamwork across roles such as scriptwriting, directing, scenography, music composition, and performance. In this way, it nurtures multiple forms of intelligence and creativity, while ensuring that every student can contribute according to their strengths.

Ultimately, the purpose of *Learning STEAM Through Theater* is to empower students to transform scientific inquiry into shared artistic expression—making learning more engaging, memorable, and impactful, while cultivating essential 21st-century skills such as problem-solving, communication, collaboration, and creativity.

The aim is to demonstrate to teachers how to implement these activities. It is not supposed to give specific STEM field lesson plans, as these should be chosen by the teacher according to his/her field. But the same activities should be realised. Examples of specific theatrical performances, scripts, music compositions are given throughout this document.

2 Module Description

2.1 Introduction

In the context of the activity, students **develop and implement a theatrical performance related to scientific concepts and learn science in a creative way**. The specific objectives of the activity, which have as a central axis the **interdisciplinary interconnection of science with aspects of art**, aiming at the enhancement of students' interest in science, involve both students and teachers. More specifically, through this activity, students comprehend **scientific concepts** and phenomena, develop a spirit of **cooperation and teamwork**, actively participate in the elaboration of scientific concepts and they **develop creative and critical thinking skills**. Also, by participating in dissemination activities and entrepreneurial actions for the promotion and support of their theatrical performance, they contribute in further **bridging school with society** and at personal level developing their **social and entrepreneurial skills**.

Teachers will be engaged in **professional development** procedures through their cooperation and the exchange of opinions, ideas and teaching material (either in person or through online learning communities). Finally, one of the main aims of the activity is to motivate more and more teachers and students and create an **educational community** that will cooperate, exchange opinions, material and best practices for science teaching and learning, that will continue after the implementation of the action.

2.2 Learning Objectives

The main aim of the Learning Science Through Theatre (LSTT) activity is to give the opportunity to primary and high school students to stage a play and dramatize scientific concepts and knowledge from the material being taught in schools.

The LSTT's domain specific objectives are to:

- Get students interested in science and research through theatrical play
- Teach students how to develop a theatrical script, relevant to a scientific topic
- Initiate the development of a theatrical performance by students, regarding a scientific topic
- Initiate contact between students and other professionals (for example directors and musicians)
- Bring schools closer to local community
- Engage parents and the general public into schools' happenings and events
- Build National-wide student networks
- Open the school to the community and involve all the stakeholders.

Towards attaining these objectives, peripheral aims are formed addressing students' needs to:

- develop understanding about scientific inquiry
- develop abilities necessary to do scientific inquiry
- identify questions and concepts that guide scientific investigations
- design and conduct theatrical scripts relevant to scientific concepts and issues
- use technology to improve investigations, communications and the development of theatrical
- performances and videos
- formulate and revise scientific scripts exploiting creativity and imagination
- recognize, analyze and imagine alternative explanations and models
- communicate a scientific argument or issue in a creative way
- develop lifelong learning skills
- develop attitudes befitting a scientific ethos
- link with science and society in a personal context

The LSTT aims at the enhancement of the students' cognitive involvement, their representation of scientific content using their cognitive processes, the students' involvement using their bodies or gestures, their emotional involvement, the social interaction and communication between them, the use of past experiences and the creation of new ones based on sociopolitical and historical framework and on beliefs and behaviors, their brain, body and emotion coordination and finally the holistic use of their personality and their motives. As a result, students manage to constructively build on each other's ideas, enhance their learning of scientific concepts, co-create and perform theatrical plays.

2.3 Available partnership opportunities

Here are some partnership opportunities you should consider in your development:

Stakeholder	Partnership description/Contribution
Parents	Supporting, as externals, the students' performances in the various steps that will follow, either by offering their expertise if relative to the thematic/scenery demands or by personally attending the final events to cheer the effort.
Local businesses	Contribute by offering assets (either financial or in other material forms needed)

Local authorities	Supporting the whole process and disseminating the project to the local community for raising the awareness and contribute to the search for financial support
NGOs	Contribute by supporting with specific activities, e.g. Art NGO by providing artists, Science NGO by providing researcher.
Artists	Professional artists will have the chance to support the development and the staging of the play thus apprenticing the young students to the artistic aspects of the chosen thematic
Researches	Researchers are entrusted to spark the students' excitement in the chosen scientific concept. Furthermore, they will ensure the validity of the scientific elements of the performance and offer valuable help to the development of the script
Research institutes	Will offer a place for informal education that is complementary needed and targeted to the success of the performance. Will also engage students in the inquiry processes of researching.

2.4 Recommended resources

There are no financial resources needed actually. Students will develop all the needed costumes, scenery etc. If they need financial contribution, they could have the support of the local authorities and/or businesses as it was already support them in the last years (since 2014). For human resources, teachers usually realise this activity during their lessons or 2 extra hours per week for at least 8 weeks. This is usually within their project-based activities. Communication with professionals will be realized in person at schools, but also online. They will need an internet connect to connect with the organisers in specific time-frames for the support, PCs to prepare any possible presentation that they would like to involved in the performance.

2.5 Age of Students Involved

9 - 12, 12 - 15, 15 – 18

2.6 Subjects Domain

Mathematics, Science, Engineering, Arts, Technology

3 Implementing the Module following the Design Thinking Approach

<table>
<tr>
<td>

FEEL

What is the problem demanding action from the schools

</td>
<td>

Phase I – Question

Students pose, select, or are given a **scientifically oriented question to investigate**. Balance and navigation through dialogue aids teachers and students in creatively navigating educational tensions, including between open and structured approaches to IBSE

The teacher chooses a chapter / module from the curriculum in which the students will be involved following the LSTT activity framework. Then, possibly on the occasion of a modern scientific subject related to this chapter, he begins a **dialogue with the students**, asking them questions. These questions will trigger a new round of questions from the students' side this time. At this point, the teacher should use these students' questions and come up with the subject that will eventually be explored and dramatized. Once the subject has been identified, **the teacher can use and implement experiential warm up exercises** both for the students to get acquainted with their body and with the rest members of the group as well as basic theatrical techniques. Some examples of exercises can be found below:

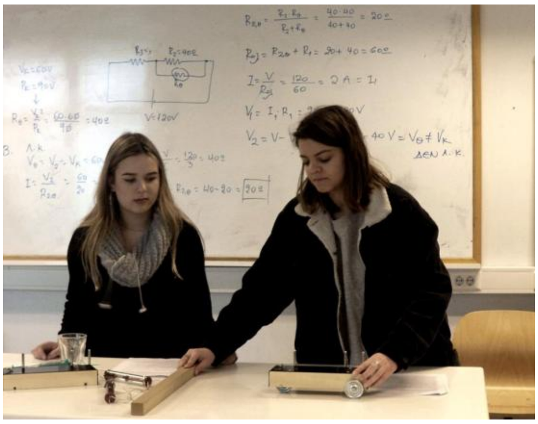
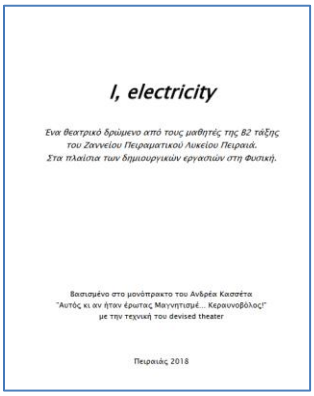
1) Students begin to move around under the instruction to continuously fill the gaps in space, without falling on each other. The moderator can stop the action and make corrections so that the space is always covered. As the group moves, the moderator gives the pace with the signal (1 → slow walking, 2 → faster ...)
2) The students gather in a circle and the moderator gives the instruction to choose a friend and an enemy but without letting them know. With his signal they start moving, trying to keep themselves constantly in between their enemy and their friend.

Phase II – Evidence

At this stage, individual and teamwork plays an important role, aiming at finding and gathering the **necessary information about the main inquiry question** that has been asked. It is also important to strengthen and **empower students to produce individual queries** and discuss the evidence they found in the various sources they sought to look for.

</td>
</tr>
</table>

	The teacher in this phase ensures that all students have **access to information** on the exploratory question, whether via the internet (eg. YouTube videos, information from scientifically valid websites, etc.) or through printed material books (e.g. from the school library). The main concern is to **coordinate the group of students in terms of searching** and collecting the necessary information, as well as aiding the search for information within the chosen topic. The information search process can be facilitated by the teacher by providing basic search guidelines (eg. suggested links to students, suggested subqueries to explore, providing search keywords for search engines, etc.) **Students** search the web for information on the question / topic they chose to explore. They can work both individually and collectively, exchanging key findings and information they have collected. 
IMAGINE *How could the schools – students act up?* *What partnerships are required?*	**Phase III – Analyze** The main characteristic of this phase is the organization and analysis of the data collected during the previous phase of the exploratory process as well as the dialogue between the students to categorize the data. **The teacher** functions more as a **facilitator of the process, and coordinates discussions** among students about the data collected. Also, encourages the creation of organized information models, and search rules / standards pursuant under which the data will be organized. To achieve this, the teacher can provide students with a **template** according to which they will categorize their data. He then encourages and coordinates the group of students to improvise and create a first version of the theatrical performance. At this stage, **students analyze and categorize the collected data** while identifying different models of organizing information. Then they make a first attempt to capture the idea and create the scenario on which their theatrical performance will be based. Essential role in this phase plays the **improvisation of students** as they attempt to set up a basic skeleton of their performance in a spontaneous way.

	 **Phase IV – Explain** A key feature of this phase is the **dialogue between students** in order to extract and decide on the possible explanations and answers for the exploratory question that have been raised and which make sense to the pupils themselves.  *I, electricity* *Ένα θεατρικό δρώμενο από τους μαθητές της Β2 τάξης του Ζαννείου Πειραματικού Λυκείου Πειραιά. Στα πλαίσια των δημιουργικών εργασιών στη Φυσική.* Βασισμένο στο μονόπρακτο του Ανδρέα Κασσέτα "Αυτός κι αν ήταν έρωτας Μαγνητισμέ... Κεραυνοβόλος!" με την τεχνική του devised theater Πειραιάς 2018 **The teacher** acts as facilitator and process coordinator while identifying and correcting possible misconceptions of students about the interpretation of the data collected in the previous phase. Sample of scripts developed during this phase (in Greek): At this stage, **students collaborate and talk about making decisions about the basic explanations they will adopt to answer the question** they have asked and then proceed with the creation of their theatrical performance. 
CREATE *Describe the activities*	**Phase V – Connect** A key feature of this phase is **interdisciplinarity,** as students conquer scientific concepts and knowledge interconnecting scientific knowledge with various forms of art. The teacher takes full advantage of the possibilities offered by the **interdisciplinary approach of teaching, as it promotes the interconnection of various scientific themes with various forms of art** (theater, music, painting). To achieve this, a communication and consultation with **specialists in the field** is pursued (specialist scientist in science education, specialized director, musician, etc.). In addition, the teacher coordinates the corresponding groups of students who have undertaken to create the script, music, costumes, etc.)

<table>
<tr>
<td></td>
<td>

Students in this phase **explore the subject spherically and find interconnections with other fields, such as the arts** (theater, music, painting, etc.). They are divided into groups according to their interests, in order to design and implement a complete theatrical performance with scientific content related to the exploratory question / theme originally set. Thus, pupils are divided into groups of directing, music production, scenography and costumes, choreography, video production, sound and lighting, promotional activities. They use all their imagination and creativity to achieve the best possible result and produce the final products in each category. Collaboration exists both in between students belonging to the same group and pupils belonging to different groups, so that the results produced are consistent.

</td>
</tr>
<tr>
<td>

SHARE

How do you plan to share the outcomes of your activities and build new partnerships?

</td>
<td>

Phase VI – Communication

The main feature of this phase is the dimension of pupils' communication, both with their classmates and with special scientists and specialized artists. In addition, communication also involves the expression of scientific concepts and findings by pupils through their theatrical performance.

Sample video of a theater performance:

https://www.youtube.com/watch?v=kmOClPpMBuA

At this stage **the teacher encourages students to communicate with scientists and artists** so that students can express and communicate the findings of their exploratory process in the best possible way to the public through their theatrical performance. The teacher has previously taken care to arrange a special scientist's visit to the science and / or artistic session (director, musician, etc.) at the school for students to address their questions. Finally, the teacher, in conjunction with the organizers of the action, takes care to ensure a specific day for a rehearsal of the group of students. **Finally, the teacher is responsible for coordinating the final performance** of the pupils.

Students in this phase **communicate with artists (directors, musicians etc.) and the scientist who may even visit the school to be consulted**. They ask them questions about various ways of improving the theatrical performance. In addition, both during their rehearsals and during their final theatrical performance, students communicate through their bodies and through various gestures scientific concepts and issues that they have explored throughout the exploratory process.

</td>
</tr>
</table>

Phase VII – Reflection

The main feature of this phase is student reflection and assessment of the exploratory process and learning.

The teacher at this stage of the exploratory process, which is the last one, discusses with the students' group what went well and what not when the students' theatrical performance was implemented. **The teacher evaluates whether all students have been involved in the creative exploratory process and completes an observation form** provided by the organizers of the action, which helps in describing and assessing by the teacher both the course of student exploratory learning and the successful - or unsuccessful - elaboration of scientific meanings by students, through embodied learning, always in the context of the curriculum of the classroom in which students are studying.

At this stage, **students** are evaluated **both by the judges (scientists and artists) of the final theatrical performance and by the audience of theatrical performance**. Then, after receiving their awards and distinctions, they discuss both with each other and with the teacher about the characteristics of the performance and the factors that contributed to the results of their final play.

4 Description of the Lesson Plans in the Module

4.1 Introduction

This module is composed from 4 Lesson Plans:

Lesson Plan 1: Introducing theatrical approaches and choosing the STEM theme for the theatrical performance

Lesson Plan 2: Developing the Story – Storytelling workshops

Lesson Plan 3: Developing music, scenery and dissemination material

Lesson Plan 4: Finalizing the performance and rehearsals

These lesson plans are guides to the teachers (and students) with the activities that should undertake in order to develop their own performance. They are not dedicated to a specific STEM field, as this is up to the teacher and students to choose.

4.2 Lesson Plan 1

<table>
<tr><td>Title</td><td colspan="3">Introducing theatrical approaches and choosing the STEM theme for the theatrical performance</td></tr>
<tr><td>Duration</td><td colspan="3">4 hours</td></tr>
<tr><td>Specific Learning Objectives</td><td colspan="3">• Initiate the development of a theatrical performance by students, regarding a scientific topic
• Initiate contact between students and other professionals (for example directors and musicians)
• Bring schools closer to local community</td></tr>
<tr><td>Key STEAM Elements</td><td colspan="3">STEM. Students should choose the specific STEM field that they would like to work with according to the guidance from the teacher.</td></tr>
<tr><td>SDG/ Sustainability / Cultural Heritage Focus</td><td colspan="3">Creative thinking, Quality Education</td></tr>
<tr><td>Materials / Resources Needed</td><td colspan="3">There is no need for specific material, just papers and pencils</td></tr>
<tr><td rowspan="3">Description of Specific Activities</td><td>Step</td><td>Description of the activities</td><td>Duration</td></tr>
<tr><td>Feel:</td><td>In this stage the teacher should start asking questions in order to understand the specific scientific notion that should be analysed. Students should start debating and come to dialogue in order to define which scientific notion should choose to work with. This depends also from the teacher concerning the field that comes from (e.g. physics, chemistry, biology, mathematics) so to guide them according to notions from these disciplines.</td><td>1 hour</td></tr>
<tr><td>Imagine:</td><td>Students should start discussing in more details about the notion and what are the</td><td>1 hour</td></tr>
</table>

		main difficulties that they observe in order to understand it. Teacher should guide them and facilitate them by giving them some resources, guides, videos where they could see how they should start thinking and imagine the performance that they should conclude with. At this stage they will need to define the specific scientific notion that they will work with (e.g. the forces in physics, the solar system in astronomy, the period table in chemistry etc.)	
	Create:	The teacher should give examples to students through resources like the Learning Science Through Theater resources https://lstt.eu/yliko/). They might start watching videos from other performances relevant to their theme so to get inspiration. They could use this link https://lstt.eu/videos/. Also, they might be able to organise a specific visit to a science museum, a theatrical play as well as to have a visit from an artist (actor, director, script writer). This should be facilitated from the teacher.	2 hours
	Share:	At this point there is no need yet to share, only to inform the rest of the teachers and the rest of the school that the team is going to prepare a specific theatrical performance about the selected scientific notion and that will be presented towards the end of the year in the Learning Science Thorough Theater Festival (www.lstt.eu).	
Follow up activities (if needed)	N/A at this stage		
Assessment / Reflection / Feedback	The teacher should fill in the observation form (pre) – See Annex Students should fill in the questionnaire (pre) – See Annex (for Secondary) or See Annex (for Primary)		
List of Educational Material (presentations, videos, reading material, exercises/worksheets, references)	*NA*		

4.3 Lesson Plan 2

Title	Developing the Story – Storytelling workshops		
Duration	8-10 hours		
Specific Learning Objectives	Teach students how to develop a theatrical script, relevant to a scientific topic		
Key STEAM Elements	The specific STEM Field that it was choose during the previews lesson with the theatrical approach that they will follow in order to develop their script (e.g. including humor)		
SDG/ Sustainability / Cultural Heritage Focus	Creative thinking, Quality Education		
Materials / Resources Needed	There is no need for specific material, just papers and pencils		
Description of Specific Activities	**Step**	**Description of the activities**	**Duration**
	Feel:	Teacher should present them the opportunities about storytelling and script developments. This could be through video presentations or through already existing presentations here. Students should start using the Heros Journey Template (here) in order to start think about their script.	1 hour
	Imagine:	The students will work in groups in order to start thinking about the story. There should meet after each session. It is proposed to have at least 2 sessions of 45 minutes each in order to develop the main points of the story on the Heros Journey Template	2 hours
	Create:	Based on their main points script they will now start developing the dialogues of the characters that will be included in the theatrical play.	5-7 hours
	Share:	At this point there is no need yet to share, only to inform the rest of the teachers and the rest of the school that the team is going to prepare a specific theatrical performance about the selected scientific notion and that will be presented towards the end of the year in the Learning Science Thorough Theater Festival (www.lstt.eu).	-
Follow up activities (if needed)	The script writing team should follow up with the rest of the teams in order to finalize the script and decide about the roles and in which students will		

	be appointed. This should be done within the 5-7 hours in the "Create" stage.
Assessment / Reflection / Feedback	The teachers should gather all the teams in order to reflect on the script. There is no need for specific tool. This could be done though through the use of Google forms or documents where all the students could comment and suggest ideas.
List of Educational Material (presentations, videos, reading material, exercises/worksheets, references)	The teacher and students should visit the following site in order to get ideas and guidance about the script: https://lstt.eu/yliko/. There they could find several materials, scripts, presentations, videos, music compositions etc.

4.4 Lesson Plan 3

Title	Developing music, scenery and dissemination material		
Duration	10 hours		
Specific Learning Objectives	How to collaborate, communicate and share information with the public. Developing teamworking skills and critical reflection.		
Key STEAM Elements	All disciplines		
SDG/ Sustainability / Cultural Heritage Focus	Creative thinking, Quality Education		
Materials / Resources Needed	There is no need for specific material, just papers and pencils		
Description of Specific Activities	**Step**	**Description of the activities**	**Duration**
	Feel:	**Exploring Emotions and Connections** • **Teacher Actions:** ○ Guides students to recall the scientific theme of the performance (e.g., climate change, sound waves, ecosystems). ○ Facilitates short warm-up activities (soundscapes, drawing images, or mood boards) to evoke emotional responses connected to the theme. ○ Encourages discussion on how music, scenery, and promotional materials influence an audience's perception and emotions. • **Student Actions:**	2 hours

		○ Reflect on how they feel about the scientific topic. ○ Share initial associations (sounds, colors, symbols, images). ○ Begin to explore sensory and emotional connections that will later inform artistic choices.	
	Imagine:	**Generating Creative Ideas** • **Teacher Actions:** ○ Organizes brainstorming sessions in three working groups: *music*, *scenery/costumes*, *dissemination/promotion*. ○ Provides prompts, such as: ▪ *Music*: "What sounds or rhythms can represent our scientific theme?" ▪ *Scenery*: "What colors, materials, and stage design could reflect the concept?" ▪ *Promotion*: "How can we communicate our story visually to invite an audience?" ○ Shares examples from professional theater or past student projects for inspiration. • **Student Actions:** ○ Work in their groups to sketch, note, or prototype ideas. ○ Use mind-maps, quick sketches, or sound experiments to envision possibilities. ○ Present early concepts to the class for feedback.	2 hours
	Create:	**Producing Materials and Elements** • **Teacher Actions:** ○ Provides access to tools (art supplies, instruments, digital software for music or design). ○ Ensures scientific accuracy remains visible in artistic choices.	5 hours

		○ Facilitates collaboration between groups (e.g., music group and choreography team, scenery and stage design). • **Student Actions:** ○ *Music group*: Compose simple rhythms, melodies, or background soundscapes reflecting the scientific theme. ○ *Scenery group*: Build models, paint backdrops, or design costumes linked to the concept. ○ *Promotion group*: Create posters, flyers, or short videos to disseminate the performance and its scientific message. ○ Refine work through feedback cycles within and across groups.	
	Share:	**Presenting and Reflecting** • **Teacher Actions:** ○ Organizes an in-class "mini-showcase" where groups present their music, scenery, and dissemination ideas. ○ Encourages constructive feedback and connections between the groups' contributions. ○ Leads a reflection session: *How do these artistic elements strengthen the scientific story we want to tell?* • **Student Actions:** ○ Present their final or prototype products to classmates. ○ Reflect on the creative process: what worked well, what challenges arose, and how the outcome communicates both art and science. ○ Prepare these elements for integration into the full performance. At this point there is no further need yet to share, only to inform the rest of the teachers and the rest of the school that the team is going to prepare a specific theatrical performance about the selected scientific notion and that will be presented towards the end of the year in the Learning	1 hour

		Science Thorough Theater Festival (www.lstt.eu).	
Follow up activities (if needed)	The Music, Scenery and Marketing/Dissemination teams should follow up with the rest of the teams in order to finalize their ides and integrate them into the script (or update the script) and decide about the roles and in which students will be appointed.		
Assessment / Reflection / Feedback	The teachers should gather all the teams in order to reflect on the productions of the Music, Scenery and Marketing/Dissemination teams. There is no need for specific tool. This could be done though through the use of Google forms or documents where all the students could comment and suggest ideas.		
List of Educational Material (presentations, videos, reading material, exercises/worksheets, references)	The teacher and students should visit the following site in order to get ideas and guidance about the music, scenery and dissemination activities: https://lstt.eu/yliko/. There they could find several materials, scripts, presentations, videos, music compositions etc. Also, students should have access to art supplies, instruments, digital software for music or design.		

4.5 Lesson Plan 4

Title	Finalizing the performance and rehearsals		
Duration	10 hours		
Specific Learning Objectives	To ensure students consolidate their learning into a cohesive performance, polish their roles, and prepare for public presentation. Specifically: • Integration of scientific content with artistic expression is clear and effective. • Learners practice teamwork, discipline, and resilience through rehearsal. • Students build confidence in public communication of science through the arts.		
Key STEAM Elements	All Disciplines		
SDG/ Sustainability / Cultural Heritage Focus	Creative thinking, Quality Education		
Materials / Resources Needed	There is no need for specific material, just papers and pencils. The rehearsals will be realised in the stage of the LSTT Festival and the students could have all the needed infrastructure, lights, microphones etc.		
Description of Specific Activities	**Step**	**Description of the activities**	**Duration**
	Feel:	**Embodying Roles and Emotions** • **Teacher Actions:** ○ Leads warm-up activities (breathing, body movement, vocal projection) to	1,5 hours

		help students focus (for warmups see also here). ○ Encourages students to reconnect emotionally with their roles and the scientific theme of the performance. ○ Frames rehearsals as a safe space where mistakes are part of the learning process. • **Student Actions:** ○ Participate in physical and vocal warm-ups to prepare mind and body. ○ Reflect on their personal connection to the story, characters, or concepts they portray. ○ Share feelings of excitement, tension, or challenges before the rehearsal starts.	
	Imagine:	**Refining Vision and Flow** • **Teacher Actions:** ○ Guides a collective discussion: *What message do we want the audience to understand?* ○ Helps students re-visualize the flow of the performance (scene transitions, timing, integration of music, scenery, and dissemination elements). ○ Suggests possible adjustments to strengthen the clarity and coherence of the narrative. • **Student Actions:** ○ Imagine how the performance will "look and feel" for the audience. ○ Collaborate on brainstorming improvements (e.g., clearer dialogue, stronger scene transitions, or refined choreography). ○ Provide peer feedback on elements that need clarification or strengthening.	1,5 hours
	Create:	**Rehearsing and Polishing the Performance** • **Teacher Actions:** ○ Organizes full or partial run-throughs of the performance.	5 hours

		o Provides targeted feedback on timing, delivery, movement, and integration of music/scenery. o Ensures groups (acting, music, scenography, promotion) work in synergy and refine their outputs. • **Student Actions:** o Rehearse lines, movements, and staging with increasing accuracy. o Integrate all creative elements (music, scenery, costumes, lighting, dissemination visuals). o Make adjustments based on feedback and repeat rehearsals to improve. o Collaborate across groups to align timing, sound cues, and scene changes.	
	Share:	**Internal Showcase and Reflection** • **Teacher Actions:** o Coordinates a final in-class rehearsal as a "mini-showcase." o Facilitates feedback and reflection on performance readiness. o Encourages students to consider both the artistic quality and the accuracy of the scientific message. o Arrange with the organisers of LSTT to visit the venue of the live performances to have a final rehearsal before the event. • **Student Actions:** o Present the full rehearsal to peers or a small internal audience. o Reflect collectively: *What works well? What needs final adjustments?* o Strengthen confidence by celebrating progress while addressing last-minute refinements. o Prepare mentally and practically for the public performance that will be presented towards the end of the year in the Learning Science Thorough Theater Festival (www.lstt.eu).	2 hours

Follow up activities (if needed)	Reflect on the live performance after the event. This could be a 1-hour session in the classroom some days after the live event.
Assessment / Reflection / Feedback	The teacher should fill in the observation form (post) – See Annex Students should fill in the questionnaire (post) – See Annex (for Secondary) or See Annex (for Primary)
List of Educational Material (presentations, videos, reading material, exercises/worksheets, references)	N/A at this stage. Just those referred within the steps above.

5 ANNEXES

5.1 Teacher Observation Form Pre

Observation Form: Information for filling out

Please fill out the form below regarding your participation in the initiative "Learning Science through Theater". It is recommended to complete it at least twice, at the beginning and the end of the intervention, or more often (e.g., in the middle) if you consider it appropriate. The idea is to track and record your thoughts, feelings, observations, and expectations during your participation. You can print and fill out the form by hand or on a computer.

The goal is to briefly mention what is happening/thoughts you have from the moment you decided to implement the intervention and describe your reactions and feelings. There are no specific rules on how to write; just try to include the following, depending on the period you are filling it out (beginning – middle – end):

- What you did
- Your thoughts
- Your feelings
- How it went
- What you learned

There is no word limit, and you can include sketches or drawings if you wish. It is important to remember that, although this form is a private feedback exercise, we, the organizers, will read it to learn more about your experience participating in the activity, which is why we ask you to be honest when filling it out. It is essential for us to have proper feedback through your opinions so we can take necessary improvement actions.

The first time you fill out the form, we would like you to record your expectations from the initiative and its implementation in your school, and in the subsequent times, keep your initial impressions in mind and think about how they may have changed and what you believe you have learned.

Below are some general questions that we would like you to consider when filling out the form:

- What do I expect to learn during the initiative?
- What activities do I believe/would like to be involved in?
- What kind of support do I expect to receive and from whom (e.g., school, organizers, colleagues, etc.)?
- What teaching methods am I thinking of using?
- Do I think the students will be interested? How many of them?
- Can an appropriate framework of freedom be created for students to express themselves and create?
- Will the activities encourage students to think creatively?

Observation Form (1st phase - Pre)

School:

Responsible teacher (name/surname /field):

School class(es)/grades:

Age of participating students:

Number of participating students:

How do I plan to start?

(e.g., how I will form the group of students, in what context the initiative will be implemented, how the main idea for the development of the theater activities will be developed, how responsibilities such as script, music, etc. will be distributed among the students)

My thoughts/goals

What are my expectations for the implementation of the initiative?

How I plan to implement the steps of the initiative?

[*The initiative adopts the design thinking model within the operation of the STEAM IDEAS' Square approach, following the competence-based framework of the project "L-STEAM" (https://lsteam.eu/) which includes the following four stages to guide students in developing their own work plans:*

- ***Feel***
- ***Imagine***
- ***Create***
- ***Share***

Follow the above stages to describe how you plan to apply them]

Description of stages	Implementation method
Feel: *Students identify the specific fields that would like to work with. It could be inspired from difficult science notions, mathematical rules or theorems, problems in their local communities (e.g., environmental). They can also choose topics related to global issues. Students observe the problems and try to engage with those that concern them, share their thoughts in groups, and create an action plan based on scientific evidence.*	
Imagine: *Students brainstorm and think about and develop creative solutions that can be easily replicated and reach the maximum number of people, causing long-term changes and having*	

an immediate impact. They can think also on how to perform specific scientific notions and phenomena based on their curriculum. They engage with external stakeholders, seek data to support their ideas, and propose a series of solutions and actions.	
Create: *Students implement their work plans (taking into account Responsible Research and Innovation - RRI issues) and interact with organizations to communicate their findings.*	
Share: *Students share the developed performances and solutions with other schools in the community, local media as well as with the community. They also participate in STEAM Performance festivals like LSTT (https://lstt.eu/) to share their performances.*	

Write down two or three significant examples that you believe will demonstrate the imagination, originality, and innovation of the students.

What theater techniques or other techniques will you apply/use?

Will music (or sound) play a role in the creation of the performance?

How to use musical/sound pieces	Ideas/description
I plan to use some ready-made recording from the internet which will be played from a computer	

I intend to create music/sound exclusively for the initiative with the aim of either being recorded or/and performed live	
I intend to use AI tools in order to create music	

Please fill out the form and send it to

info@scienceview.gr

Thank you for your participation and your time!

5.2 Teacher Observation Form Post

Observation Form: Information for filling out

Please fill out the form below regarding your participation in the initiative "Learning Science through Theater". It is recommended to complete it at least twice, at the beginning and the end of the intervention, or more often (e.g., in the middle) if you consider it appropriate. The idea is to track and record your thoughts, feelings, observations, and expectations during your participation. You can print and fill out the form by hand or on a computer.

The goal is to briefly mention what is happening/thoughts you have from the moment you decided to implement the intervention and describe your reactions and feelings. There are no specific rules on how to write; just try to include the following, depending on the period you are filling it out (beginning – middle – end):

- What you did
- Your thoughts
- Your feelings
- How it went
- What you learned

There is no word limit, and you can include sketches or drawings if you wish. It is important to remember that, although this form is a private feedback exercise, we, the organizers, will read it to learn more about your experience participating in the activity, which is why we ask you to be honest when filling it out. It is essential for us to have proper feedback through your opinions so we can take necessary improvement actions.

The first time you fill out the form, we would like you to record your expectations from the initiative and its implementation in your school, and in the subsequent times, keep your initial impressions in mind and think about how they may have changed and what you believe you have learned.

Below are some general questions that we would like you to consider when filling out the form:

- What do I expect to learn during the initiative?
- What activities do I believe/would like to be involved in?
- What kind of support do I expect to receive and from whom (e.g., school, organizers, colleagues, etc.)?
- What teaching methods am I thinking of using?

- Do I think the students will be interested? How many of them?
- Can an appropriate framework of freedom be created for students to express themselves and create?
- Will the activities encourage students to think creatively?

Observation Form (2nd phase - Post)

School:

Responsible teacher (name/surname /field):

School class(es)/grades:

Age of participating students:

Number of participating students:

How we started / How the initiative ultimately concluded?

(e.g.: how the student team was formed, in what context the initiative was implemented, how the main idea for the theater development activities was developed, how responsibilities such as script, music, etc. were allocated among the students)

My thoughts/ observations

How well was the initiative ultimately implemented?

What did I learn from the participation in the initiative?

How were the steps of the initiative ultimately implemented?

[*The initiative adopts the design thinking model within the operation of the STEAM IDEAS' Square approach, following the competence-based framework of the project "L-STEAM" (*[*https://lsteam.eu/*](https://lsteam.eu/)*) which includes the following four stages to guide students in developing their own work plans:*

- ***Feel***
- ***Imagine***
- ***Create***
- ***Share***

Follow the above stages to describe how you applied them]

Description of stages	Implementation method
Feel: *Students identify the specific fields that would like to work with. It could be inspired from difficult science notions, mathematical rules or theorems, problems in their local communities (e.g., environmental). They can also choose topics related to global issues. Students observe the problems and try to engage with those that concern them, share their thoughts in groups, and create an action plan based on scientific evidence.*	
Imagine: *Students brainstorm and think about and develop creative solutions that can be easily replicated and reach the maximum number of people, causing long-term changes and having an immediate impact. They can think also on how to perform specific scientific notions and phenomena based on their curriculum. They engage with external stakeholders, seek data to support their ideas, and propose a series of solutions and actions.*	
Create: *Students implement their work plans (taking into account Responsible Research and Innovation - RRI issues) and interact with organizations to communicate their findings.*	
Share: *Students share the developed performances and solutions with other schools in the community, local media as well as with the community. They also participate in STEAM Performance festivals like LSTT (https://lstt.eu/) to share their performances.*	

Mention two or three significant incidents from the implementation of the initiative that you believe demonstrate the imagination, originality, and innovation of the students.

Mention two or three significant examples from the implementation of the initiative that demonstrate the use of a) individual gestures, b) whole body movements, c) the emotional involvement of the students, and d) facial expressions, for the representation of scientific concepts.

Provide one example of how the students conveyed a scientific concept: a) verbally, b) digitally, c) through Art (e.g., with music, with choreography, with the creation of lyrics, etc.).

Mention some unexpected events and how you ultimately dealt with them.

What theater techniques or other techniques did you apply/utilize?

Describe the role that music (or sound) played in creating the performance according to the following cases: a) Pre-recorded sound from the internet that was played from a computer, b) Music/Sound created, recorded, or performed live specifically for the performance. Specifically: description, parts of the performance you chose to hear, functionality (serving the stage action, conveying a particular concept, etc.).

Please fill out the form and send it to

info@scienceview.gr

Thank you for your participation and your time!

5.3 Students Questionnaire – Secondary Education (Pre)

Dear students,

Thank you for your participation!

All the questionnaires are part of a research project and the answers you provide are strictly confidential! Your teacher will not assess or grade you!

General Questions

1. Your school

(Drop down list that will include all schools registered for the initiative)

2. Which grade are you in? *

1st Grade of Lower High School

2nd Grade of Lower High School

3rd Grade of Lower High School

1st Grade of Upper High School

2nd Grade of Upper High School

3rd Grade of Upper High School

3. Your birth month *

(Field that must be filled with a number, between 1-12)

4. Your birth day *

(Field that must be filled with a number, between 1-31)

To better understand what you think and feel about STEAM subjects (Science, Technology, Engineering, Arts, Mathematics) at school, please indicate your level of agreement with the following statements:

	Disagree Completely	Disagree	Neither Agree Nor Disagree	Agree	Agree Completely
Learning STEAM subjects is interesting	☐	☐	☐	☐	☐
I am curious about discoveries in the sciences	☐	☐	☐	☐	☐
The sciences I learn are related to my life	☐	☐	☐	☐	☐
Learning STEAM subjects makes my life more meaningful	☐	☐	☐	☐	☐
I enjoy learning STEAM subjects	☐	☐	☐	☐	☐
Learning STEAM subjects will help me have a good job	☐	☐	☐	☐	☐
Understanding STEAM subjects will benefit my professional development	☐	☐	☐	☐	☐
I know that STEAM subjects will give me an advantage in my future career development	☐	☐	☐	☐	☐
I will use problem-solving skills in my professional development	☐	☐	☐	☐	☐
My career will involve STEAM subjects	☐	☐	☐	☐	☐
I study enough to learn STEAM subjects	☐	☐	☐	☐	☐
I prepare well for science exams and laboratories	☐	☐	☐	☐	☐
I make a significant effort to learn STEAM subjects	☐	☐	☐	☐	☐
I dedicate enough time to learn STEAM subjects	☐	☐	☐	☐	☐
I use specific creative and interdisciplinary methods to study STEAM subjects effectively	☐	☐	☐	☐	☐
I believe I can get a very good grade in STEAM subjects	☐	☐	☐	☐	☐
I am confident that I will do well on STEAM exams	☐	☐	☐	☐	☐

I believe I can acquire knowledge and skills in STEAM subjects	☐	☐	☐	☐	☐
I am confident that I understand STEAM subjects	☐	☐	☐	☐	☐
I am sure that I will do well in laboratories and activities of the STEAM subjects	☐	☐	☐	☐	☐
I am interested in getting a good grade in STEAM exams and laboratories	☐	☐	☐	☐	☐
It is important for me to get a very good grade in STEAM subjects	☐	☐	☐	☐	☐
I am concerned about the grade I will receive in STEAM subjects	☐	☐	☐	☐	☐
I like to do better than my peers in STEAM exams	☐	☐	☐	☐	☐

5.4 Students Questionnaire – Secondary Education (Post)

Dear students,

Thank you for your participation!

All the questionnaires are part of a research project and the answers you provide are strictly confidential! Your teacher will not assess or grade you!

General Questions

1. Your school

(Drop down list that will include all schools registered for the initiative)

2. Which grade are you in? *

1st Grade of Lower High School

2nd Grade of Lower High School

3rd Grade of Lower High School

1st Grade of Upper High School

2nd Grade of Upper High School

3rd Grade of Upper High School

3. Your birth month *

(Field that must be filled with a number, between 1-12)

4. Your birth day *

(Field that must be filled with a number, between 1-31)

Please indicate your level of agreement with the following statements regarding the implementation of the activity:

	Disagree Completely	Disagree	Neither Agree Nor Disagree	Agree	Agree Completely
I really liked this activity	☐	☐	☐	☐	☐
The activity was fun	☐	☐	☐	☐	☐
I think it was a boring activity	☐	☐	☐	☐	☐
The activity did not hold my attention at all	☐	☐	☐	☐	☐
I would describe the activity as very interesting	☐	☐	☐	☐	☐
I think the activity was enjoyable	☐	☐	☐	☐	☐
While I was engaged in the activity, I was thinking about how much I liked it	☐	☐	☐	☐	☐
I think I am very good at this activity	☐	☐	☐	☐	☐
I think I performed very well in this activity compared to other students	☐	☐	☐	☐	☐
After participating in the activity, I felt quite capable	☐	☐	☐	☐	☐
I am satisfied with my performance in the activity	☐	☐	☐	☐	☐
I had the necessary skills for the implementation of the activity	☐	☐	☐	☐	☐
It was an activity that I could not respond to very well	☐	☐	☐	☐	☐
During my participation in the activity, I did not feel nervous at all	☐	☐	☐	☐	☐
During my participation in the activity, I felt a lot of tension	☐	☐	☐	☐	☐
During my participation in the activity, I was very relaxed	☐	☐	☐	☐	☐
I was anxious while working on this activity	☐	☐	☐	☐	☐
I felt pressure while we were implementing the activity	☐	☐	☐	☐	☐

I had the option to choose whether to engage in this activity	☐	☐	☐	☐	☐
I felt that it was not my choice to do this activity	☐	☐	☐	☐	☐
I did not really have the choice for the implementation of this activity	☐	☐	☐	☐	☐
I felt like I had to be involved in the activity	☐	☐	☐	☐	☐
I engaged in this activity because I had no other choice	☐	☐	☐	☐	☐
I engaged in this activity because I wanted to	☐	☐	☐	☐	☐
I engaged in this activity because I had to					

To better understand what you think and feel about STEAM subjects (Science, Technology, Engineering, Arts, Mathematics) at school, please indicate your level of agreement with the following statements:

	Disagree Completely	Disagree	Neither Agree Nor Disagree	Agree	Agree Completely
Learning STEAM subjects is interesting	☐	☐	☐	☐	☐
I am curious about discoveries in the sciences	☐	☐	☐	☐	☐
The sciences I learn are related to my life	☐	☐	☐	☐	☐
Learning STEAM subjects makes my life more meaningful	☐	☐	☐	☐	☐
I enjoy learning STEAM subjects	☐	☐	☐	☐	☐
Learning STEAM subjects will help me have a good job	☐	☐	☐	☐	☐
Understanding STEAM subjects will benefit my professional development	☐	☐	☐	☐	☐
I know that STEAM subjects will give me an advantage in my future career development	☐	☐	☐	☐	☐
I will use problem-solving skills in my professional development	☐	☐	☐	☐	☐
My career will involve STEAM subjects	☐	☐	☐	☐	☐
I study enough to learn STEAM subjects	☐	☐	☐	☐	☐
I prepare well for science exams and laboratories	☐	☐	☐	☐	☐
I make a significant effort to learn STEAM subjects	☐	☐	☐	☐	☐
I dedicate enough time to learn STEAM subjects	☐	☐	☐	☐	☐
I use specific creative and interdisciplinary methods to study STEAM subjects effectively	☐	☐	☐	☐	☐
I believe I can get a very good grade in STEAM subjects	☐	☐	☐	☐	☐
I am confident that I will do well on STEAM exams	☐	☐	☐	☐	☐
I believe I can acquire knowledge and skills in STEAM subjects	☐	☐	☐	☐	☐

I am confident that I understand STEAM subjects	☐	☐	☐	☐	☐
I am sure that I will do well in laboratories and activities of the STEAM subjects	☐	☐	☐	☐	☐
I am interested in getting a good grade in STEAM exams and laboratories	☐	☐	☐	☐	☐
It is important for me to get a very good grade in STEAM subjects	☐	☐	☐	☐	☐
I am concerned about the grade I will receive in STEAM subjects	☐	☐	☐	☐	☐
I like to do better than my peers in STEAM exams	☐	☐	☐	☐	☐

5.5 Students Questionnaire – Primary Education (Pre)

Dear students,

Thank you for your participation! All the questionnaires are part of a research study, and the answers you provide will be strictly confidential! Your teacher will not evaluate or grade you!

General Questions

1. Your school

(Drop down list where all schools registered for the action will be recorded)

2. What grade are you in? *

1st Grade

2nd Grade

3rd Grade

4th Grade

5th Grade

6th Grade

3. Your birth month *

(Required field that must be filled with a number between 1-12)

4. Your birth day *

(Required field that must be filled with a number between 1-31)

To better understand what you think and feel about the STEAM subjects (Science, Technology, Engineering, Arts, Mathematics) at school, please answer each of the following statements:

	Never	Rarely	Sometimes	Usually	Always
Learning STEM subjects is interesting	☐	☐	☐	☐	☐
I am curious about discoveries in science	☐	☐	☐	☐	☐
The science subjects I learn are related to my life	☐	☐	☐	☐	☐
Learning science subjects makes my life more meaningful	☐	☐	☐	☐	☐
I enjoy learning science subjects	☐	☐	☐	☐	☐
I study enough to learn science subjects	☐	☐	☐	☐	☐
I prepare well for science classes	☐	☐	☐	☐	☐
I put in enough effort to learn science subjects	☐	☐	☐	☐	☐
I dedicate enough time to learn science subjects	☐	☐	☐	☐	☐
I believe I can get a very good grade in science subjects	☐	☐	☐	☐	☐
I believe I can develop skills in science subjects	☐	☐	☐	☐	☐
I am confident that I understand science subjects	☐	☐	☐	☐	☐
I am sure that I will do well in activities related to science subjects	☐	☐	☐	☐	☐
I worry about the grade I will get in science subjects	☐	☐	☐	☐	☐

5.6 Students Questionnaire – Primary Education (Post)

Dear students,

Thank you for your participation! All the questionnaires are part of a research study, and the answers you provide will be strictly confidential! Your teacher will not evaluate or grade you!

General Questions

1. Your school

(Drop down list where all schools registered for the action will be recorded)

2. What grade are you in? *

1st Grade

2nd Grade

3rd Grade

4th Grade

5th Grade

6th Grade

3. Your birth month *

(Required field that must be filled with a number between 1-12)

4. Your birth day *

(Required field that must be filled with a number between 1-31)

Respond to each of the following statements according to how often you felt something from the below while participating in the activity:

	Never	Rarely	Sometimes	Usually	Always
I really enjoyed this activity	☐	☐	☐	☐	☐
The activity was fun and creative	☐	☐	☐	☐	☐
I think it was a boring activity	☐	☐	☐	☐	☐
The activity did not hold my attention at all.	☐	☐	☐	☐	☐
While participating in this activity, I was thinking about how much I liked it	☐	☐	☐	☐	☐
I think I am very good at this activity	☐	☐	☐	☐	☐
I think I performed very well in this activity compared to other students	☐	☐	☐	☐	☐
After participating in the activity, I felt quite capable	☐	☐	☐	☐	☐
I am satisfied with my performance in this activity	☐	☐	☐	☐	☐
I was quite prepared for this activity	☐	☐	☐	☐	☐
It was an activity that I couldn't respond to very well	☐	☐	☐	☐	☐
During my participation in the activity, I did not feel nervous at all	☐	☐	☐	☐	☐

During my participation in the activity, I felt a lot of tension	☐	☐	☐	☐	☐
During my participation in the activity, I was very relaxed	☐	☐	☐	☐	☐
I was anxious while working on this activity					
I felt pressure while we were implementing the activity					
I had the option to choose whether to participate in this activity					
I had the opportunity to express my opinion					

To better understand what you think and feel about the STEAM subjects (Science, Technology, Engineering, Arts, Mathematics) at school, please answer each of the following statements:

	Never	**Rarely**	**Sometimes**	**Usually**	**Always**
Learning STEM subjects is interesting	☐	☐	☐	☐	☐
I am curious about discoveries in science	☐	☐	☐	☐	☐
The science subjects I learn are related to my life	☐	☐	☐	☐	☐
Learning science subjects makes my life more meaningful	☐	☐	☐	☐	☐
I enjoy learning science subjects	☐	☐	☐	☐	☐
I study enough to learn science subjects	☐	☐	☐	☐	☐
I prepare well for science classes	☐	☐	☐	☐	☐
I put in enough effort to learn science subjects	☐	☐	☐	☐	☐
I dedicate enough time to learn science subjects	☐	☐	☐	☐	☐
I believe I can get a very good grade in science subjects	☐	☐	☐	☐	☐
I believe I can develop skills in science subjects	☐	☐	☐	☐	☐
I am confident that I understand science subjects	☐	☐	☐	☐	☐

I am sure that I will do well in activities related to science subjects	☐	☐	☐	☐	☐
I worry about the grade I will get in science subjects	☐	☐	☐	☐	☐

Module 2

Learning STEAM through Music

(Part 1)

Co-funded by the European Union

Funded by the European Union through the CREATIVE EUROPE Programme. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or European Education and Culture Executive Agency (EACEA). Neither the European Union nor the granting authority can be held responsible for them.

Project n°: 101173445 — CREA-CULT-2024-COOP

Our project partners:

Author(s): Vasilia Philippou, Olia Tsivitanidou

Institution(s): INQUIRIUM

Date: August 2025

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Commission. Neither the European Union nor the granting authority can be held responsible for them.

Table of contents

1 Introduction

1.1 Purpose of the document

The purpose of this document is to provide a clear and structured overview of the Learning science through music module developed during the implementation of the STEAM Innovation project. It serves as a guide for educators, outlining the rationale, objectives, and expected outcomes of the activities, while ensuring alignment with the broader goals of integrating science, technology, engineering, arts, and mathematics in creative and meaningful ways. By describing the lesson plans in detail, the document supports teachers in planning and implementing activities that foster interdisciplinary learning, creativity, and critical thinking. Furthermore, it ensures consistency across the module and offers a reference point for collaborators, partners, and stakeholders involved in the development and delivery of the program.

2 Module Description

2.1 Introduction

In this activity, students explore scientific concepts through the combined lenses of music, technology, and artistic creation. Through the engagement of the students in music composition, instrument building, and the use of emerging digital tools such as artificial intelligence for sound and image generation, students merge scientific inquiry with creative expression. The activity aims to deepen understanding of core STEM principles, such as waves, vibration, and ecosystems—while highlighting the power of the arts and digital innovation as tools for learning. Through hands-on experimentation, prompt-based exploration, and collaborative performance, students translate scientific phenomena into musical and visual representations. This interdisciplinary approach not only strengthens knowledge acquisition and skill development but also cultivates creativity, digital literacy, and values such as collaboration, innovation, ethical awareness, and sustainability.

2.2 Learning objectives

<u>**Knowledge Acquisition**</u>

● Explain the fundamental scientific principles of sound (waves, pitch, loudness, timbre, data-to-sound mapping).
● Explore and describe how sound is generated, transmitted, and perceived both naturally and digitally.
● Summarize the basics of musical expression, including rhythm, melody, harmony, and timbre.
● Identify how scientific and environmental phenomena (e.g., temperature, rainfall, ecosystems) can be represented through sound and music.
● Explain the concept and applications of emerging technologies such as generative AI, AR, and VR in creative sound and art.

<u>**Competence Development**</u>

● Formulate creative and scientific questions (e.g., "What story can data tell through sound?") and conduct guided exploration.
● Apply knowledge of sound to design original compositions, sonifications, or soundscapes.
● Use digital tools (Chrome Music Lab, Beepbox, Online Sequencer, AI tools) to compose, edit, and present audio-visual works.
● Collaborate in groups to plan, create, and present projects such as sonic landscapes, immersive AR/VR experiences, or AI-generated artworks.
● Develop skills in experimentation, design thinking, interdisciplinary problem-solving, and critical reflection on the role of technology in art.

<u>**Attitudes**</u>

● Cultivate curiosity and appreciation for the intersections between science, technology, and the arts.
● Foster creativity, imagination, and open-mindedness in connecting data, sound, and digital media.
● Build confidence in presenting, performing, and explaining creative outputs to peers and wider audiences.
● Encourage teamwork, responsibility, and initiative in collaborative, project-based learning.

● Promote sustainability and cultural awareness by using meaningful datasets (e.g., climate, biodiversity, heritage) and accessible everyday materials in creative work.

2.3 Available partnership opportunities

Here are some partnership opportunities you should consider in your development:

Stakeholder	Partnership description/Contribution
Parents	Support the musical performances by offering expertise or attending events.
Local businesses	Provide financial or material contributions (e.g., instruments, venues).
Local authorities	Assist with promotion and community engagement.
NGOs	Offer workshops or resources linking music and science.
Artists	Guide students in composition and performance techniques.
Researchers	Verify scientific accuracy and provide insights on scientific concepts.
Research institutes	Host workshops and provide resources for hands-on scientific experimentation.

2.4 Recommended resources

Students will mainly use digital music composition software, basic instruments available at school, and simple recording equipment provided by schools or supported by local businesses. A wide range of online tools can support students' creative expression and scientific inquiry. These include

<u>Digital Tools and Platforms</u>

- Online Synthesizers & Sound Explorers: Chrome Music Lab (Oscillators, Kandinsky, Song Maker), MZ-101, Mod Synth IO, Viktor NV-1, Web Synths – allowing students to manipulate sound, pitch, timbre, and rhythm digitally.
- Samplers & Soundscape Tools: Playtronica, Sampulator, or environmental sound libraries (e.g., freesound.org), enabling exploration of thematic soundscapes.
- Sequencers & Drum Machines: BeepBox, Online Sequencer, Drumbit, and MusicLab Song Maker, for rhythmic loops, melodic patterns, and structured compositions.
- Digital Audio Workstations (DAWs): BandLab, Soundtrap, and AudioTool – offering multi-track recording, mixing, and advanced editing.
- AI Creativity Tools: Suno, Amper Music (text-to-music), DALL·E, Craiyon, Leonardo.ai, Copilot Designer (text-to-image), and Melobytes (image-to-sound) for experimenting with generative AI.

<u>AR/VR Tools</u>

- CoSpaces Edu, Google Arts & Culture AR, Artivive, Merge Cube, or QR code-based experiences to connect visuals, data, and immersive soundscapes.

Notation & Visualisation Tools

- Noteflight and MusicLab Kandinsky, for students interested in writing or visualising sound through images.

In addition to digital tools, students are encouraged to create musical instruments using everyday materials (e.g. rubber bands, cardboard tubes, metal cans), and to engage in hands-on experiments. Also, suggested materials for further experimentation during the FEEL phase, include tuning forks, mallets, bowls, plastic wrap, rubber bands, water, and dry rice. These can be used in activities such as: Experiment #1: How does sound move? – where vibrations are made visible by striking a tuning fork and placing it in water; Experiment #2: Sound Waves – There's a drum in my Ear? – where students simulate how the human eardrum responds to sound using plastic wrap and rice.

Minimal financial resources may be necessary for specialised equipment or software licenses, potentially funded by local authorities or businesses. Teachers typically facilitate the activity during school hours or through extra-curricular sessions. Online communication tools will support consultations with artists and researchers

2.5 Age of students involved

9 – 12

2.6 Subject domain

Science, Technology, Engineering, Arts, Mathematics

3 Implementing the Module following the Design Thinking Approach

FEEL *What is the problem demanding action from the schools*	**Phase I – Question** Teachers initiate discussion by introducing a scientific or environmental theme from the curriculum, such as sound waves, ecosystems, climate data, or the solar system. Students brainstorm how this topic might be explored and expressed through sound, music, or digital media. To spark curiosity, teachers facilitate short listening and sound-making exercises, guiding students to notice differences in pitch, loudness, rhythm, and timbre, and to reflect on the emotions or images sound can create. They may play examples ranging from natural recordings (e.g., birdsong, ocean waves) to experimental works like John Cage's 4'33", as well as AI-generated sounds and images, to show how science and art can merge in innovative ways. Music and sound are introduced not only as creative tools but also as powerful methods to enhance scientific understanding, vocabulary, and engagement. This approach draws on research highlighting music's role in learning through its emotional impact, social nature, and accessibility. Schools can further connect science and art during interdisciplinary events, such as Italy's "Settimana della Scienza," where students present projects linking data, sound, and creativity. **Phase II – Evidence** Students undertake individual and group research to deepen their scientific understanding and connect it to musical possibilities. For example, those exploring ecosystems may investigate animal communication and environmental soundscapes, while others studying wave properties might analyse vibration, frequency, and resonance. Students interested in sustainability may work with climate or biodiversity datasets and imagine how these could be transformed into sound sequences. Teachers guide this research by recommending reliable sources such as scientific websites, educational simulations, and sound databases, while also encouraging experimentation with digital platforms like Chrome Music Lab or Online Sequencer. At the same time, students engage in hands-on investigations using tuning forks, rice membranes, water vibrations, or recycled classroom objects to observe how sound is produced and altered. This foundational experience equips them to select appropriate digital tools, materials, or instruments to represent scientific ideas accurately. The research activity leads towards two possible outcomes: students either compose an original digital or AI-assisted sound piece or design and construct their own musical instruments, culminating in a short performance or presentation that demonstrates both scientific understanding and artistic creativity.
IMAGINE *How could the schools – students act up?* *What partnerships are required?*	**Phase III – Analyse** Students analyse and categorise their research findings, exploring how scientific data and concepts can be expressed through sound, music, or immersive media. They discuss connections between data patterns and musical elements such as pitch, tempo, rhythm, timbre, and dynamics, and begin mapping these relationships through mind maps, sketches, or simple sound diagrams. For students focusing on composition, this phase includes experimenting with digital platforms such as Chrome Music Lab, BeepBox, or Online Sequencer to test how datasets or natural sounds can be represented musically. Those designing

	instruments investigate the structure and function of different sound sources, including both traditional families of instruments and everyday materials, reflecting on how the physical properties of objects influence sound quality. Students may also look at examples from cultural heritage, such as the tamburello in Italy or the laouto in Cyprus, and analyse how these instruments produce sound in relation to vibration, resonance, and airflow. The emphasis is on linking scientific understanding to creative possibilities, whether through digital sound design, AI-generated outputs, or DIY instrument construction. **Phase IV – Explain** In this phase, student groups collaboratively refine their creative concepts, specifying in detail how musical or digital choices correspond to scientific ideas. For those developing compositions, they define how changes in pitch, rhythm, harmony, or timbre reflect patterns in data or scientific phenomena, such as rising pitch to represent increasing temperature or rhythmic changes to mimic biodiversity variation. Students designing instruments explain the scientific principles behind their sound production—such as resonance, vibration, or air pressure—and justify their choices of materials and design. Those working with AI or AR/VR tools describe how generative outputs or immersive elements connect to the scientific content they are exploring. Groups prepare supporting materials, including explanatory notes, sound samples, sketches, or prototypes, which document the logic behind their artistic and scientific decisions. Teachers provide formative feedback on both the clarity of the scientific explanations and the coherence of the artistic expression, while collaborations with local music conservatories, universities, or creative labs can offer further mentoring on acoustics, performance, and design, reinforcing the connection between scientific knowledge and artistic practice.
CREATE *Describe the activities*	**Phase V – Connect** Students compose and produce their projects using a variety of tools and materials, drawing on the scientific and creative knowledge built in earlier phases. Those focusing on digital composition may use platforms such as Chrome Music Lab, BeepBox, Online Sequencer, BandLab, or Soundtrap to create original sound pieces, experimenting with pitch, rhythm, and timbre to represent scientific phenomena or emotional ideas. Others may integrate AI tools like Suno or Amper Music for generative compositions, or DALL·E, Craiyon, and Melobytes to connect images and sound in multimodal artworks. Students designing their own instruments construct prototypes from recycled or everyday items, carefully documenting how choices of material and shape affect resonance, timbre, and pitch, linking back to their scientific investigations. Some groups may choose to develop immersive experiences using AR/VR platforms such as CoSpaces Edu or Artivive, where visual markers or QR codes trigger soundscapes, blending technology with creative storytelling. Within each group, students specialise in roles such as composition, instrument design, sound editing, digital production, or presentation planning, ensuring that all elements of their performance or installation are coherent and scientifically informed. Partnerships with local organisations, cultural institutions, or sustainability initiatives can enrich this stage, as demonstrated by projects like Bologna's "RicicleMusica," where recycled materials were transformed into instruments, combining environmental awareness with sound design.

SHARE *How do you plan to share the outcomes of your activities and build new partnerships?*	**Phase VI – Communication** Performances and exhibitions are organised during open school days, local festivals, or community events where parents, peers, and invited experts can engage with the students' work. Depending on the project, students may present live sound compositions, showcase instruments they have constructed, or demonstrate immersive AR/VR installations where visual markers or QR codes trigger soundscapes and audiovisual pieces. Each presentation is accompanied by a short explanation of the scientific principles underlying the work, helping audiences connect the creative output to concepts such as sound waves, data patterns, or acoustic properties. Projects may also be shared digitally through school websites, blogs, or online galleries, expanding the impact to a broader audience and creating a lasting archive of student creativity. This public sharing fosters not only community engagement but also develops students' confidence in presenting interdisciplinary ideas in both artistic and scientific contexts. **Phase VII – Reflection** Following the presentations, students reflect individually and collaboratively on their learning journey. They evaluate their understanding of the scientific concepts explored, their growth in creativity, teamwork, and digital skills, and the effectiveness of their artistic communication. Reflection may take the form of journals, exit slips, group discussions, or short multimedia self-assessments, encouraging students to articulate both strengths and areas for improvement. Peer and teacher feedback, as well as responses from audiences and external experts, are gathered to help students consider how their work was received and how it could be refined. This phase emphasises celebrating achievements while also recognising challenges, and it highlights the broader value of linking science, art, and technology to promote creativity, sustainability, and meaningful expression.

4 Description of the Lesson Plans in the Module

4.1 Sound as Art and Science

4.1.1 Lesson Plan 1

<table>
<tr><td>Title</td><td colspan="3">Discovering the magic of sound</td></tr>
<tr><td>Duration</td><td colspan="3">1 hour</td></tr>
<tr><td>Specific Learning Objectives</td><td colspan="3">The students will be able to:
- explain what sound is and how it travels
- identify the sound properties (pitch, loudness, quality)
- explore how sound can be used creatively in art
- express ideas and feeling through sound-making and listening</td></tr>
<tr><td>Key STEAM Elements</td><td colspan="3">Science (sound waves) and Music (creative sound expression)</td></tr>
<tr><td>SDG/ Sustainability / Cultural Heritage Focus</td><td colspan="3">Encouraging creativity and expression through science and art.</td></tr>
<tr><td>Materials / Resources Needed</td><td colspan="3">- Audio clips (John Cage’s 4’33”, sounds from nature, everyday sounds)
- Speakers or headphones
- Simple sound-making items: bottles, paper, rubber bands, pencils, etc.
- Drawing paper and colored pencils
- Tablet or phone with a voice recorder app (optional)</td></tr>
<tr><td rowspan="3">Description of Specific Activities</td><td>Step</td><td>Description of the activities</td><td>Duration</td></tr>
<tr><td>Feel:</td><td>The students are introduced to the emotional impact of sound. The teacher plays a variety of short sound clips such as ocean waves, laughter, thunder, ticking clocks, or even silence. Students are encouraged to close their eyes while listening and reflect on how each sound makes them feel. After listening, they choose one sound that inspired them the most and draw a simple picture that expresses their emotional or imaginative response. This helps students begin to associate sound with feeling and expression.</td><td>10 min</td></tr>
<tr><td>Imagine:</td><td>The students explore how sound can spark creativity. The teacher briefly introduces John Cage’s 4’33” in child-friendly terms, explaining that it’s a piece where the performer doesn’t play any notes—</td><td>10 min</td></tr>
</table>

		allowing the surrounding environment and ambient sounds to become the "music." Students listen quietly to a short segment and reflect on what they hear in the "silence." This is followed by listening to natural sounds like birdsong, rain, or waterfalls. Students are then invited to imagine a place or story that the sound might belong to, and they can either draw or write a short paragraph describing their imagined scene.	
	Create:	The students work in small groups to explore the artistic possibilities of everyday sounds. Each group receives or collects safe classroom materials such as bottles, paper, pencils, rulers, or containers. The teacher provides a few examples of how these objects can be used to make sounds (e.g., tapping, rubbing, blowing). Students are then encouraged to experiment with creating different sound qualities—varying pitch (high/low), volume (loud/soft), and timbre (smooth, rough, echoing). Using their created sounds, each group composes a short "sound piece" that tells a story or sets a mood, lasting 30 to 60 seconds. They are encouraged to give their sound piece a title and think about what kind of feeling or scene it might communicate.	25 min
	Share:	Each group presents their sound piece to the class. As each group performs, the rest of the class listens and reflects on what they hear and feel. After each performance, the teacher leads a short discussion, asking questions like, "What sounds did you notice?" or "What did this piece remind you of?" Students are encouraged to give kind and constructive feedback to their peers. The presenting group also shares how they created their sounds and what they wanted the audience to feel or imagine. This final step supports communication skills, creative thinking, and peer appreciation.	15 min
Follow up activities (if needed)	- Go on a "sound walk" around the school to record or write down interesting sounds. - Create a "class soundscape" collage using recorded or drawn sounds.		

Assessment / Reflection / Feedback	- Participation in listening and group work - Completion of the drawing or written reflections - Simple self-assessment: "What did I learn about sound today?" - Teacher observation and feedback on creativity and teamwork
List of Educational Material (presentations, videos, reading material, exercises/worksheets, references)	- PowerPoint: "What is Sound?" (includes pitch, volume, timbre) - Audio clips: ✓ *4'33"* by John Cage (short segment) ✓ Natural sounds (rain, birds, waves) - Worksheet: "Sound Explorer" (match sounds to feelings, short reflections) - Colored pencils, markers, sound-making objects from classroom - Optional: Kid-friendly app like "Soundtrap" or "GarageBand" for simple recording

4.1.2 Lesson Plan 2

Title	Sound synthesis workshop: Drawing emotions with sound		
Duration	1 hour		
Specific Learning Objectives	The students will be able to: - Explain the concept of synthesised sound - Explore how digital tools like Chrome music lab can be used to create simple sound compositions - Connect different types of sounds (timbres) with feelings or moods - Express creativity through technology and music		
Key STEAM Elements	**Science** (sound waves, synthesis, **Technology** (digital tools), **Arts** (music, emotional expression)		
SDG/ Sustainability / Cultural Heritage Focus	Fostering digital creativity, emotional literacy, and expression through accessible technology.		
Materials / Resources Needed	- Computers or tablets with internet access - Chrome Music Lab (https://musiclab.chromeexperiments.com) – particularly the *"Oscillators"*, *"Kandinsky"*, or *"Song Maker"* tools - Headphones (optional) - Projector/screen for teacher demonstration - Drawing materials (for hybrid sound/emotion sketching)		
Description of Specific Activities	**Step**	**Description of the activities**	**Duration**
	Feel:	Start by asking the class an open question: "Can a sound feel happy, sad, scary, or funny?" Encourage brief responses and give relatable examples. Then, play 4–5 short pre-selected sound clips—such as a high-	10 min

		pitched bell, a low rumble, a buzzing synthesizer, birdsong, or eerie wind—and ask students to identify the mood or feeling each sound expresses. For each sound, students draw a simple emoji or a facial expression that represents how that sound made them feel. This primes students to associate sound with emotional meaning, laying the foundation for deeper creative work.	
	Imagine:	The teacher demonstrates either the *Kandinsky* or *Oscillators* tool on Chrome Music Lab using a shared screen or projector. These tools allow students to visually "draw" or manipulate sound in real-time. The Kandinsky tool, for instance, translates drawings into playful tones and shapes, while the Oscillators tool lets students experiment with tone types and pitch by interacting with colorful blobs. After the demonstration, students explore the tools in pairs or individually. As they listen to the sounds they generate, prompt them to imagine what kind of place, character, or scene might go with those sounds. They can sketch what they imagine or write a brief description. For example, a rising whistle might suggest a rocket launch, while a deep wobble might feel like a dinosaur's footsteps. This step builds creative association and encourages playful experimentation.	10 min
	Create:	Later on, the students put their imagination to use by composing a short digital "sound story" using *Song Maker* or *Oscillators* on Chrome Music Lab. The goal is to create a 30–60 second piece that communicates a feeling or tells a mood-based story through sound. The teacher can guide this step by first asking students to choose one emotion—such as joy, calm, excitement, or mystery. Then, students work independently to build their piece using the interface, focusing on aspects like pitch (high or low), rhythm (fast or slow), and timbre (the tone quality of the sound). They are encouraged to give their composition a title that reflects the feeling or idea behind it. If possible, students should save their sound or take a screenshot to share later.	25 min

		This activity integrates music, technology, and emotional expression.	
	Share:	Lastly, students present their digital compositions to the class. One at a time, they either play their saved sound or describe what they made and how they used specific sounds to show a feeling or tell a story. The rest of the class listens and gives simple feedback, guided by the teacher with questions like: "What emotion did this sound make you feel?" or "What did this remind you of?" Encourage students to be kind and thoughtful in their feedback, celebrating creativity and effort. This sharing moment builds confidence and reinforces the connection between sound, imagination, and emotion.	15 min
Follow up activities (if needed)	- Create a class "sound gallery" where students link their sound pieces with drawings or short stories. - Introducing layering or collaboration with shared compositions in Chrome Music Lab.		
Assessment / Reflection / Feedback	- Observation of student engagement and participation - Short written reflection or exit ticket: "What was your favorite sound? What did it remind you of?" - Assessment checklist for creativity, effort, and ability to express emotion through sound - Option to record and share sound pieces with families or on a class blog		
List of Educational Material (presentations, videos, reading material, exercises/worksheets, references)	- Chrome Music Lab tools: https://musiclab.chromeexperiments.com - Teacher demo slides: "Exploring Timbre and Emotion with Sound" - Sound clip library for emotion-matching activity (can be teacher-curated or from online resources)		

4.1.3 Lesson Plan 3

Title	Turning data into music: Sound mapping through numbers
Duration	1 hour
Specific Learning Objectives	The students will be able to: - Recognise and describe common environmental sounds - Identify how numbers (like temperature data) con be creatively represented through sounds - Work collaboratively to convert simple datasets into short audio pieces using digital tools

<table>
<tr><td></td><td colspan="3">- Build connections between science (data) and the arts (music/sound design)</td></tr>
<tr><td>Key STEAM Elements</td><td colspan="3">Science (Environmental data), Technology (music sequencers), Engineering (data-to-sound mapping), Arts (creative composition), Mathematics (data interpretation)</td></tr>
<tr><td>SDG/ Sustainability / Cultural Heritage Focus</td><td colspan="3">Using sound as a creative medium to explore and communicate environmental information (e.g., temperature, pollution, biodiversity).</td></tr>
<tr><td>Materials / Resources Needed</td><td colspan="3">- Computers or tablets with internet access
- Online Sequencer (https://onlinesequencer.net) or Beepbox (https://beepbox.co)
- Headphones (optional)
- Printed or projected datasets (e.g., hourly temperature readings, rainfall over a week)
- Whiteboard and markers for mapping data-to-sound ideas</td></tr>
<tr><td rowspan="3">Description of Specific Activities</td><td>Step</td><td>Description of the activities</td><td>Duration</td></tr>
<tr><td>Feel:</td><td>Start by asking the class an open question: “Can a sound feel happy, sad, scary, or funny?” Encourage brief responses and give relatable examples. Then, play 4–5 short pre-selected sound clips—such as a high-pitched bell, a low rumble, a buzzing synthesizer, birdsong, or eerie wind—and ask students to identify the mood or feeling each sound expresses. For each sound, students draw a simple emoji or a facial expression that represents how that sound made them feel. This primes students to associate sound with emotional meaning, laying the foundation for deeper creative work.</td><td>10 min</td></tr>
<tr><td>Imagine:</td><td>The teacher demonstrates either the Kandinsky or Oscillators tool on Chrome Music Lab using a shared screen or projector. These tools allow students to visually "draw" or manipulate sound in real-time. The Kandinsky tool, for instance, translates drawings into playful tones and shapes, while the Oscillators tool lets students experiment with tone types and pitch by interacting with colorful blobs. After the demonstration, students explore the tools in pairs or individually. As they listen to the sounds they generate, prompt them to imagine what kind of place, character, or scene might go with those sounds. They can sketch what they imagine or write a brief description. For example, a</td><td>10 min</td></tr>
</table>

		rising whistle might suggest a rocket launch, while a deep wobble might feel like a dinosaur's footsteps. This step builds creative association and encourages playful experimentation.	
	Create:	Later on, the students put their imagination to use by composing a short digital "sound story" using *Song Maker* or *Oscillators* on Chrome Music Lab. The goal is to create a 30–60 second piece that communicates a feeling or tells a mood-based story through sound. The teacher can guide this step by first asking students to choose one emotion—such as joy, calm, excitement, or mystery. Then, students work independently to build their piece using the interface, focusing on aspects like pitch (high or low), rhythm (fast or slow), and timbre (the tone quality of the sound). They are encouraged to give their composition a title that reflects the feeling or idea behind it. If possible, students should save their sound or take a screenshot to share later. This activity integrates music, technology, and emotional expression.	25 min
	Share:	Lastly, students present their digital compositions to the class. One at a time, they either play their saved sound or describe what they made and how they used specific sounds to show a feeling or tell a story. The rest of the class listens and gives simple feedback, guided by the teacher with questions like: "What emotion did this sound make you feel?" or "What did this remind you of?" Encourage students to be kind and thoughtful in their feedback, celebrating creativity and effort. This sharing moment builds confidence and reinforces the connection between sound, imagination, and emotion.	15 min
Follow up activities (if needed)	- Invite students to bring in or collect a small dataset (e.g., sound levels at recess, heart rate, plant growth, water usage at home) and create new sound sequences - Combine all group compositions into a "Data Symphony" and present it in an assembly or share it with parents		
Assessment / Reflection / Feedback	- Short reflection journal or exit slip: "What was the most interesting part of turning data into music?" or "What did you learn about sound or data today?"		

	- Peer feedback after each performance: "What did you hear? Did the sound match the data story?"
List of Educational Material (presentations, videos, reading material, exercises/worksheets, references)	- Online tools: ✓ https://onlinesequencer.net ✓ https://beepbox.co - Pre-prepared temperature or weather datasets (CSV or printed) - "Data-to-Sound Mapping" worksheet (includes number-to-note conversion table, planning grid) - Teacher slides introducing data sonification (with visual + audio examples) - Environmental sound clips (e.g., from freesound.org or preloaded samples)

4.1.4 Lesson Plan 4

<table>
<tr><td>Title</td><td colspan="3">Launch of the final project: Design a sonic landscape from data</td></tr>
<tr><td>Duration</td><td colspan="3">1 hour</td></tr>
<tr><td>Specific Learning Objectives</td><td colspan="3">The students will be able to:
- Collaborate to form a project group and share creative responsibilities
- Select a data-related theme meaningful to the group
- Begin designing a sound-based artistic interpretation (sonification) of that dataset
- Develop a shared concept that combines data understanding with artistic sound expression</td></tr>
<tr><td>Key STEAM Elements</td><td colspan="3">Science (data themes like climate, growth), Technology (digital music tools), Engineering (design planning), Arts (creative sound design), Math (data interpretation and scaling)</td></tr>
<tr><td>SDG/ Sustainability / Cultural Heritage Focus</td><td colspan="3">Encouraging students to reflect on environmental or cultural data and represent it artistically through sound helps develop systems thinking, awareness, and personal expression.</td></tr>
<tr><td>Materials / Resources Needed</td><td colspan="3">- Chart paper, markers, sticky notes
- Sample datasets (e.g., plant growth over time, weather patterns, temperature at historical sites, local air quality, etc.)
- Internet-enabled devices with access to Online Sequencer (https://onlinesequencer.net), Beepbox (https://beepbox.co), or Chrome Music Lab
- Teacher slide presentation for project guidelines and theme suggestions
- Classroom projector or screen</td></tr>
<tr><td rowspan="2">Description of Specific Activities</td><td>Step</td><td>Description of the activities</td><td>Duration</td></tr>
<tr><td>Feel:</td><td>Students need to think about how data connects to real life and how sound can help us experience information differently.</td><td>10 min</td></tr>
</table>

		The teacher initiates a brainstorming discussion by asking, “What kind of stories can data tell?” and “Have you ever seen or used a graph or chart? What if we could hear it instead?” The teacher then shows 2–3 examples of real-world datasets—such as a week's temperature readings, rainfall in a rainforest, or plant growth over time—and encourages students to describe what they notice and imagine what each dataset might *sound like*. For example, does increasing temperature feel like a rising melody? Could plant growth be a slow, calm rhythm? Students may suggest emotions or mental images that come to mind. This discussion helps them understand that data isn’t just numbers—it can be full of meaning, patterns, and emotional resonance.	
	Imagine:	The teacher introduces the **Final Project**: each group of students will create a sound-based artwork—a “sonic landscape”—inspired by a dataset. The teacher explains that this is a creative project where data becomes music, and the students become both scientists and composers. Several example themes are presented visually on the board or via a slide presentation, such as: • Climate patterns from ancient civilizations (e.g., average monthly temperatures in Ancient Egypt) • Weekly plant growth in the school garden • Air quality readings in a city over a day • Sound levels in different parts of the school • Sunrise and sunset times across seasons For each theme, the teacher gives a quick idea of how data could be converted to sound (e.g., higher temperature = higher pitch, more rainfall = longer notes). Students are encouraged to imagine how their chosen data could “sound” and what story or emotion they might want to tell.	10 min

		They can sketch or jot down quick thoughts as they begin to form creative connections.	
	Create:	Students form groups of 3–4 based on shared interest in a dataset or theme. Once in groups, they choose a dataset from those provided or suggest one of their own (with teacher approval). Each group receives a **Project Planning Worksheet**, where they begin outlining their sonic concept. This includes: • What is their chosen dataset? • How will they map the numbers to sound elements like pitch, rhythm, volume, or instrument? • What mood, feeling, or story do they want their sonic landscape to express? • What digital tool will they use (e.g., Beepbox, Online Sequencer, or Chrome Music Lab)? • What roles will each group member take? Students may begin sketching sound ideas on paper, choosing instruments in Beepbox, or experimenting with short sequences on a laptop. The teacher circulates, offering support and prompting deeper thinking with questions like: "How will your music show change over time?" or "Does the sound match the mood of your data?"	25 min
	Share:	Lastly, each group presents a short overview of their project idea to the rest of the class. This is not a full performance, just a draft concept presentation. Each group briefly shares: • The dataset they selected • How they plan to represent it with sound • What emotion, ideas, or messages do they want their sonic piece to communicate As each group presents, the class listens actively and offers encouraging feedback or questions. The teacher guides the discussion with prompts like: "What's	10 min

		something you liked about this idea?" or "What other sounds might match that data?" The goal of this phase is to help groups strengthen their concept before they move into the composition phase in future sessions.	
Follow up activities (if needed)	- Students begin collecting, organizing, or researching data for their final composition. - Groups can create a visual storyboard of their sonic landscape using drawings, diagrams, or digital slides. - Prepare a shared digital folder where students can save their sound files, drafts, and notes.		
Assessment / Reflection / Feedback	- Teacher observation of group participation and collaboration - Review of project planning worksheets (completeness, clarity of ideas) - Informal group check-ins: "What's your sound idea so far?" - Exit ticket or journal prompt: "What excites you most about your project?" or "What do you still need to figure out?" - Feedback after concept presentations to support idea refinement		
List of Educational Material (presentations, videos, reading material, exercises/worksheets, references)	- Project Launch Slide Deck: explaining goals, theme ideas, tools - Printed datasets or sources for real-world data (e.g., NASA Climate Kids, local weather data, school garden logs) - Project Planning Worksheet (includes sections for data theme, sound mapping plan, intended emotion, tools needed) - Sound Design Brainstorming Sheet (optional) - Access to tools like Online Sequencer, Beepbox, or Chrome Music Lab - Audio samples from past student work (if available) or inspirational sonification examples from YouTube or museums		

4.2 AI and Immersive Worlds

4.2.1 Lesson Plan 1

Title	Generative AI for Art and Music: Exploring machines as creative partners
Duration	1 hour
Specific Learning Objectives	The students will be able to:

<table>
<tr><td></td><td colspan="3">

- Explain the concept of generative AI and how it can create music and art
- Explore how AI tools like Amper Music, Suno and DALL-E work in creative processes
- Define the basics of prompt engineering and how it affects AI-generated outputs.
- Discuss ethical aspects of AI in the arts (e.g., originality, authorship)
- Engage in hands-on experimentation with AI-generated outputs

</td></tr>
<tr><td>Key STEAM Elements</td><td colspan="3">Science (AI technology), Technology (AI tools and interfaces), Arts (music and image generation), Ethics (digital citizenship)</td></tr>
<tr><td>SDG/ Sustainability / Cultural Heritage Focus</td><td colspan="3">Promoting digital literacy, creativity, and critical thinking.

Encouraging discussion about ethics, fairness, and responsible AI use.</td></tr>
<tr><td>Materials / Resources Needed</td><td colspan="3">

- Internet-enabled computers or tablets
- Access to:
Suno.ai or Amper Music (for text-to-music demos)
DALL·E, Craiyon, Leonardo.ai, Microsoft Copilot (Designer) or Artbreeder (for text-to-image generation)
- Projector for showing demo videos and student examples
- Whiteboard and markers

</td></tr>
<tr><td rowspan="3">Description of Specific Activities</td><td>Step</td><td>Description of the activities</td><td>Duration</td></tr>
<tr><td>Feel:</td><td>The lesson begins with a whole-class discussion inviting students to share what they already know about artificial intelligence. Questions like “What do you think AI can do?” or “Have you seen a computer make something creative?” help students connect their existing experiences (such as voice assistants or YouTube suggestions) to the idea of AI in the arts. The teacher then shows short, age-appropriate video clips or examples of AI-generated music (using tools like Suno or Amper) and AI-generated images (from platforms such as DALL·E or Craiyon). Students are asked to describe how the artworks make them feel—Do they sound joyful, strange, calming, or surprising? This opening segment encourages emotional engagement and builds curiosity around AI as a new kind of creative tool.</td><td>10 min</td></tr>
<tr><td>Imagine:</td><td>Next, the class explores the concept of AI as a “creative partner” rather than a replacement for human artists. The teacher shows a comparison: one artwork or song created by a person, and one generated by</td><td>10 min</td></tr>
</table>

		an AI tool. Without revealing which is which, students guess which one they believe was made by a human and explain their reasoning. This sparks discussion on authorship, creativity, and perception. Students are then invited to imagine what kind of project they might create with an AI collaborator. Using drawing or writing, they sketch out their idea: for example, "a robot composing a lullaby," or "a magical forest painted in neon colors." This helps them develop a concept for the hands-on creation phase.	
	Create:	The teacher demonstrates how the way a request is phrased influences the output. For example, typing simply "a dragon" produces a generic result, but asking for "a dragon dancing in outer space in neon colours, digital art style" generates something far more detailed and unique. A few quick examples are shown to illustrate how changing style words, moods, or levels of detail can transform what the AI produces. Students are then given time to experiment with themselves. In pairs or small groups, they first try generating music using Suno or Amper by entering descriptive prompts such as "calm piano music for bedtime" or "fast drumming for a race." They listen carefully to what the AI generates and note how closely it matched what they expected. Next, they try image creation with tools such as DALL·E, Craiyon, Leonardo, or Copilot. They begin with a simple prompt, for example "a tree," and then try a more detailed version such as "a glowing tree with colourful lanterns at night, painted in watercolor style." They compare the two outputs and discuss how the added details made the result richer or more imaginative. Throughout the process, they record their prompts, results, and reflections on a worksheet. The goal is not only to produce outputs but to experience how their words shape the outcome, discovering the power of prompt engineering through playful experimentation.	25 min
	Share:	Finally, the class gathers to share and reflect. Each group shows one or two	15 min

	examples of what they created, whether it is an image or a short piece of music, and they explain the prompts they used. Their classmates respond by sharing what the outputs made them feel, what they reminded them of, or what they found surprising. This sharing takes the form of a mini gallery walk or whole-class discussion where students move from being individual creators to members of a community of digital artists. The teacher guides the conversation with reflection questions such as “Did the AI create what you expected?” and “Is this still your art if the machine helped?” Students are encouraged to think critically about what role AI plays in their creativity and how they can use such tools responsibly. This stage not only celebrates their achievements but also deepens their understanding of authorship, collaboration, and ethics in the age of generative AI.
Follow up activities (if needed)	- Students remix or improve their AI-generated artwork using traditional methods (e.g., drawing on top, writing lyrics for music). - Start a digital class gallery of AI+Human collaborative pieces. - Hold a debate or discussion: “Should AI art be allowed in contests?” or “Can AI win a Grammy or an art prize?”
Assessment / Reflection / Feedback	- **Participation** in discussion and experimentation - **Creative engagement**: student’s ability to generate ideas and use prompts effectively - **Exit slip or journal prompt**: “What did I create with AI?” “How would I improve it?” “What did I learn about working with technology today?” - Teacher observations of student curiosity, collaboration, and critical thinking
List of Educational Material (presentations, videos, reading material, exercises/worksheets, references)	- Demo videos from: ✓ Suno.ai demo ✓ DALL·E or YouTube examples of generative AI art - Slides introducing the concept of generative AI - Worksheet: “My AI Art/Music Idea” (includes space for prompt, sketch, and reflection) - Websites/tools: ✓ https://suno.ai ✓ https://www.ampermusic.com ✓ https://openai.com/dall-e ✓ https://www.craiyon.com

	- Suggested reading: age-appropriate article or video on "What is Generative AI?"

4.2.2 Lesson Plan 2

Title	From images to sound: Exploring visual and sonic creativity with AI		
Duration	1 hour		
Specific Learning Objectives	The students will be able to: - Explain how images and sound can be connected through digital tools. - Explore how artificial intelligence can transform one type of sensory input (visual) into another (audio) - Reflect on how this transformation changes the way we interpret and experience art - Use an online tool to generate music from images and describe the relationship between the original visual input and the resulting sound - Practice creative thinking, emotional expression, and teamwork		
Key STEAM Elements	**Science and Technology** (understanding AI transformation processes), **Engineering** (exploring input-output systems in digital tools), **Arts** (creating and interpreting visual and musical art)**, and Mathematics** (understanding patterns and structures in images and sound).		
SDG/ Sustainability / Cultural Heritage Focus	Access to digital creativity and critical thinking skills. Students also reflect on how different forms of media can represent culture and emotion.use.		
Materials / Resources Needed	- Laptops or tablets with internet access - Projector or smartboard - AI image-generation tool (e.g., DALL·E, Craiyon) - Melobytes (https://melobytes.com) or similar image-to-sound generator - Drawing materials (paper, pencils, colored markers) - Speakers for sharing sound pieces - Reflection worksheets or journals		
Description of Specific Activities	**Step**	**Description of the activities**	**Duration**
	Feel:	The teacher begins the lesson by projecting a series of abstract or surreal images—some created by AI, and others made by humans. Students are invited to simply observe, then share how each image makes	10 min

		them feel. The teacher guides a class discussion by asking: “When you look at this picture, what kind of mood does it create?” or “If this picture made a sound, what would it sound like?” Students are encouraged to describe these imagined sounds with words—like “bouncy,” “slow,” “sharp,” or “echoey”—and to draw a quick picture or symbol that represents what they imagine the sound might look like. This exercise allows students to explore the emotional and sensory connections between what they see and what they might hear, setting the stage for multimodal thinking. It also helps students begin building the imaginative link between images and sound that will be central to the later parts of the activity.	
	Imagine:	The teacher introduces the idea that computers can “read” pictures and generate sounds based on the information they interpret—such as shapes, colors, and textures. Using a class demonstration, the teacher shows how an online tool like **Melobytes** can convert an uploaded image into sound. As the tool generates the audio, students are encouraged to listen closely and compare the sound to the original image. The teacher might ask: “Do you hear anything that reminds you of the colors or shapes we saw?” or “Does the sound match the feeling you got from the image?” Next, each student chooses or creates their own AI-generated image using a tool like Craiyon or DALL·E. Alternatively, if internet access is limited, the teacher can prepare a set of AI-generated images in advance for students to select from. Students then imagine what kind of sound their chosen image *should* make—describing it in words or through drawing. This phase helps students internalize the process of translating one artistic form into another, encouraging both creativity and interpretation.	10 min
	Create:	Students now use the **Melobytes** tool to upload their selected images and convert them into audio. The teacher supports students by guiding them through the process: uploading an image, selecting music styles or options, and generating the	25 min

		sound. Each student listens to the audio their image has produced. Afterward, students are asked to reflect on a few guiding questions: "Does this sound match what you imagined before?" "What does this sound make you think of now?" "What would you change if you could?" Students then record their thoughts in their journals or worksheets and give their sound artwork a title. If time allows, students are invited to create a second version by changing the image slightly (e.g., adding colors or shapes) and observing how the sound changes. This reinforces experimentation, iteration, and the connection between visual design choices and auditory outcomes. The activity emphasizes process over perfection and encourages students to think like artists and designers.	
	Share:	To close the session, students present their "image-sound artworks" to the class. Each student or group shows their original image, plays the generated sound, and shares a few thoughts about how the two forms are connected. The teacher facilitates group discussion by prompting classmates to respond with questions such as: "What did the sound make you feel?" or "If you didn't see the image, what would you have imagined?" This encourages active listening and appreciation of peers' creative decisions. Finally, the class reflects together on how different people can interpret the same image or sound differently. This opens up a conversation about subjectivity in art and music and highlights the power of creative tools to inspire varied experiences and emotions.	15 min
Follow up activities (if needed)	- Creating a full "sound gallery," where each artwork is paired with its AI-generated music and presented in a classroom exhibit - Compare soundtracks created from different images or explore the opposite: converting sounds or recorded music into drawings or abstract visuals - Collaborative project where groups design a short multimedia "story" using AI-generated images and audio transitions to express a journey or scene.		
Assessment / Reflection / Feedback	Teachers assess student understanding and creativity through observation during the hands-on creation process and by reviewing student reflections in their journals or worksheets. Key assessment tools include:		

	- Student participation in group discussion - The quality of reflection (e.g., did the student describe how the sound matched or didn't match the image?) - **Creativity in prompt writing, image design, and sonic interpretation** - Peer feedback during the sharing session - A short self-assessment asking: "What did I enjoy?" "What was challenging?" "What would I try next time?" Teachers may also use simple rubric scoring creativity, use of digital tools, ability to explain their process, and engagement during sharing.
List of Educational Material (presentations, videos, reading material, exercises/worksheets, references)	- Online tools: Melobytes, Craiyon, DALL·E - Example AI-generated images and sound files for demonstration - Reflection worksheets or student journals - Devices with internet access - Projector/speakers for class sharing - Optional videos explaining AI art and sound generation (e.g., YouTube demos or teacher-recorded walkthroughs)

4.2.3 Lesson Plan 3

Title	Stepping into new worlds: Introduction to AR and VR for young creators
Duration	1 hour
Specific Learning Objectives	The students will be able to: - Distinguish between Augmented Reality (AR) and Virtual Reality (VR) - Explain how each is used in the world of digital art and storytelling - Reflect on how immersive technologies can change the way we learn, create, and experience the world. - Explore real-life examples of immersive installations and imagine their own AR/VR-inspired environment - Engage with creative thinking and storytelling to express ideas for an interactive digital space
Key STEAM Elements	**Science** (understanding perception and digital technology), **Technology** (exploring AR and VR tools), **Engineering** (how AR/VR environments are built), **Arts** (immersive storytelling and spatial design), **and Mathematics** (understanding scale, space, and dimension in virtual environments).
SDG/ Sustainability / Cultural Heritage Focus	Fostering digital literacy and creative technology use in the classroom. Students will also explore how immersive environments can be used to preserve and share cultural heritage, such as virtual museum tours or AR apps that explain historical landmarks.
Materials / Resources Needed	- Projector or smartboard - Internet access and speakers

	- Tablets or smartphones (if available) - Printed worksheets or sketchbooks - Videos showing examples of AR and VR in art or education - Simple VR cardboard headset (optional, for demonstration only)		
Description of Specific Activities	**Step**	**Description of the activities**	**Duration**
	Feel:	To begin, students are invited to explore what they already know about AR and VR. The teacher writes both terms—**Augmented Reality** and **Virtual Reality**—on the board and asks students to guess what each might mean. Some may say, “VR is like a video game you can walk inside,” or “AR is like Pokémon GO.” The teacher then introduces the concept in simple language: **AR adds digital things to the real world**, while **VR creates a completely digital world** that we can enter and explore. To help students feel the difference, the teacher shows two short video clips: one showing someone using AR (e.g., pointing a phone at a book to see it come to life), and another showing VR (e.g., a person wearing a headset and exploring an underwater world). After watching, students describe how each experience made them feel. They may use words like “excited,” “confused,” “curious,” or “surprised.” This sets an emotional foundation and helps students engage their senses.	10 min
	Imagine:	Next, the class dives into creative imagination. The teacher presents real examples of **immersive art installations**—such as the teamLab exhibitions, where digital projections respond to people's movements, or VR art museums that allow users to “walk through” famous paintings. Students are asked to imagine themselves inside these virtual spaces: “What would you see, hear, and feel if you were inside a painting or a story?” The teacher guides the students to close their eyes for a minute and pretend they’re entering a virtual world. Afterward, students open their eyes and sketch what their imagined space might look like. It could be a floating castle in the sky, a glowing underwater garden, or a classroom on Mars. The teacher encourages them to label objects in their drawing and think about what kinds of	10 min

		interactions would happen in their imagined environment. This activity strengthens spatial thinking and begins the transition from understanding technology to designing with it.	
	Create:	In this phase, students work either individually or in small groups to **design a simple AR or VR art idea**. If tablets or devices are available, the teacher introduces a child-friendly tool such as **CoSpaces Edu** (demo version) or the **Google Arts & Culture** app's AR features. Students can try placing a virtual object (like an ancient statue or a 3D model) into the real-world classroom through AR or look around a virtual 360° space. If devices are not available, the activity can be paper-based: each group chooses either AR or VR and creates a storyboard or poster of a future art experience. For AR, students can imagine a mural that changes when viewed through a tablet or a sculpture that talks when scanned. For VR, they might design a theme park that exists only in virtual space or an interactive story world. The teacher guides them with questions such as: "Where does this experience take place?" "What do people do inside it?" "What makes it special?" This allows students to apply their knowledge creatively and take ownership of their ideas.	25 min
	Share:	Students now present their AR/VR art experience to the class. They describe whether they chose AR or VR, where the experience takes place, and how people interact with it. If using devices, students can show what they built or explored. If working on paper, each group displays their drawing or poster and explains their design. The teacher encourages classmates to respond using prompts like: "What do you like about their idea?" or "How would you feel inside that space?" This discussion gives students a chance to learn from each other and to realize the diversity of ideas and feelings that digital environments can inspire. Finally, the teacher asks reflection questions: "What's the difference between using AR and being inside VR?" and "Would you like to make your own virtual world in	15 min

	the future?" Students may record their answers in journals or reflect aloud.
Follow up activities (if needed)	- Students can build their VR/AR spaces in more detail using design platforms like Tinkercad (for 3D modeling) or CoSpaces Edu (for immersive storytelling - Take part in a class project to create a virtual art gallery, where each student contributes a digital artwork and writes an explanation
Assessment / Reflection / Feedback	Assessment is conducted informally through observation during activities and presentations. Key points for evaluation include: - Can the student clearly explain the difference between AR and VR? - Did they contribute creative ideas during the design phase? - Did their final artwork (drawing, presentation, or demo) reflect an understanding of immersive spaces? - Were they able to reflect on their experience using sensory and emotional language? Teachers may also provide a short reflection form asking students: - "What did I learn about AR and VR today?" - "What was my favorite part of the lesson?" - "If I could design any virtual space, what would it be?" Peer feedback during the sharing session helps reinforce presentation and listening skills.
List of Educational Material (presentations, videos, reading material, exercises/worksheets, references)	- Short introduction videos: "What is AR and VR?" (e.g., TED-Ed, YouTube Kids) - Demo clips of immersive art installations (e.g., teamLab, The VR Museum of Fine Art) - Google Arts & Culture app with AR features - CoSpaces Edu (demo access for building simple VR spaces) - Cardboard VR headset (for demonstration only) - Drawing materials (paper, markers, pencils)

4.2.4 Lesson Plan 4

Title	Designing immersive experience: Using sound and Music in AR storytelling
Duration	1 hour
Specific Learning Objectives	The students will be able to: - Conceptualize and sketch out an immersive experience that begins with a physical "marker" and leads to a music- or sound-based digital response when scanned - Explain how user experiences can be triggered by visuals and enhanced with sound, and how flowcharts and sketches can help organize interactive design - Plan how their own musical landscapes unfold as a story or mood journey when activated by AR.

Key STEAM Elements	**Science** (Sensory perception and user interaction), **Technology** (Trigger-based media systems and basic AR logic), **Engineering** (planning user pathways through interactive media), **Arts** (Sound design, emotional storytelling through music, and visual marker creation), **and Mathematics** (sequencing, logical ordering, and flowcharting).
SDG/ Sustainability / Cultural Heritage Focus	students explore how digital experiences can preserve and share stories, emotions, and environments through sound and interaction. If students choose nature sounds, cultural instruments, or local history as their music themes, they contribute to preserving and reimagining cultural heritage through immersive design.
Materials / Resources Needed	- Sketch paper or storyboards - Flowchart templates or blank graph paper - Colored pencils and markers - Audio clips (student-created or sample soundscapes from previous lessons) - Printed examples of AR markers (used for reference) - Optional: digital devices with sound playback or QR code demonstration tools - Reference examples: simple marker-triggered demos (e.g., Merge Cube, Artivive) - speakers or headphones for reviewing musical clips

Description of Specific Activities

Step	Description of the activities	Duration
Feel:	The class begins with a short audio experience to refocus students on sound. The teacher plays a few short sound clips—such as gentle ocean waves, echoing footsteps in a hallway, or an upbeat tune with rhythmic claps—and asks students: "What do you feel when you hear this? What might you see if this sound started when you scanned a drawing?" This warm-up reminds them how music and sound can shape emotion, story, and imagination in immersive environments. Students then reflect briefly on what kind of mood they might want to create with sound in their own experiences.	10 min
Imagine:	In their groups, students revisit the idea that AR can be used to trigger emotional or narrative experiences by combining a visual marker with a musical or sonic world. Each group begins brainstorming what their own "marker" will look like—a symbol, object, character, or even abstract design. They decide what happens when it is scanned: Will a calm melody start? Will an exciting musical story begin? What mood should the user feel first, and how does it change? For	10 min

		example, a group might draw a tree as their marker and trigger a sound journey from spring to winter using music and ambient nature sounds. The goal here is for each group to clearly imagine how their sound will unfold: what starts the journey, what transitions happen, and what the user hears by the end.	
	Create:	Each group now begins designing two essential pieces of their immersive experience: 1. **The Physical Marker**: They sketch the visual that a user will scan—this could be a drawing of an animal, object, character, or shape that represents their theme. It should be bold, clear, and symbolic. 2. **The User Flow**: Using a flowchart or sequence map, they detail what happens after the scan. They decide what music or sound plays first, how the scene might shift (for example, from calm to loud, or from one instrument to another), and how long it lasts. If they've created sounds in previous lessons (e.g., using Melobytes, Chrome Music Lab, or Suno), they can choose which tracks to include and when. Some groups may illustrate this like a comic strip, while others label each step of the user experience with descriptions such as "Birdsong begins," "Rain fades in," or "Drums start building intensity." Students are encouraged to think of this as an interactive story told through music. Each group ensures their soundscape has a clear beginning, middle, and end, even if it's only 30–60 seconds long. If technology allows, groups can test ideas using sound editing tools or recording their own short clips.	25 min
	Share:	Each group presents their marker sketch and user flow to the rest of the class. They describe the experience they want the user to have: what they see when the marker is	15 min

<table>
<tr><td></td><td></td><td>scanned, what kind of music or sound begins, and how the emotional tone changes throughout the soundscape. They explain how their image and their music work together. For example, a group with a spiral-shaped marker might say, “We chose this shape because it reminds us of a whirlpool, and our sound gets more intense like spinning water.” As other students listen, they give feedback like, “That part sounded magical,” or “I think the music fit the story really well.” This stage helps students reflect on how effectively their ideas connect visuals, sound, and emotion—and how the user might experience the result.</td><td></td></tr>
<tr><td>Follow up activities (if needed)</td><td colspan="3">- Students can digitize their marker and actually link it to the sound using simple AR creation tools like Artivive, CoSpaces, or even QR codes that play audio files.
- Students can create a mock gallery walk, where each marker is taped to a wall and a classmate “plays the sound” manually using a device. The experience is still immersive but led by human imagination and storytelling.</td></tr>
<tr><td>Assessment / Reflection / Feedback</td><td colspan="3">Assessment focuses on creativity, teamwork, and clarity of experience design. The teacher may use a rubric or checklist to evaluate:
• Originality and design of the marker
• Coherence and emotion in the soundscape
• Logical organization of the user flow
• Clarity in presentation and explanation
• Team collaboration and reflection on feedback
At the end, students respond to reflection questions:
• “Did your music match the feeling you wanted?”
• “Was your user journey easy to understand?”
• “What would you do differently next time?”
Optionally, students write a short paragraph explaining the mood their soundscape creates and how they designed it to evolve over time.</td></tr>
</table>

List of Educational Material (presentations, videos, reading material, exercises/worksheets, references)	- Teacher slide deck: "How Sound Shapes Experience" - Flowchart and storyboard worksheets - Examples of AR-triggered audio installations - Paper and drawing supplies - Optional audio playback tools (Bluetooth speaker, classroom tablet, headphones) - Sound clips or recordings from previous lessons - Examples of real-world immersive experiences with sound (e.g., museum audio guides, digital soundwalks)

4.3 Creation and Final Presentation

4.3.1 Lesson Plan 1

Title	Developing the augmented sonoscape: Sound and image in motion
Duration	1 hour
Specific Learning Objectives	The students will be able to: - Explain how to combine hand-crafted and AI-generated sounds with images to form a unified audiovisual experience - Use basic digital tools to edit and synchronize audio with visuals, producing a short video or animated slideshow that simulates an augmented reality-style sonoscape - Experiment with layering different types of audio and reflect on how timing, pacing, and rhythm affect user perception
Key STEAM Elements	**Science** (sound waves, pitch, and frequency interaction with digital formats), **Technology** (use of digital audio workstations (DAWs) and video editing software), **Engineering** (synchronization of media elements), **Arts** (sound design, timing, rhythm, and visual storytelling), **and Mathematics** (duration, sequence, timing, and waveform structure).
SDG/ Sustainability / Cultural Heritage Focus	Students explore ethical creation using AI-generated content. They reflect on remixing, sourcing, and curating their digital materials responsibly, choosing to highlight natural environments, local traditions, or imagined futures through sound and visuals.
Materials / Resources Needed	- Computers or tablets with: ✓ **Audacity** (for audio editing) ✓ **PowerPoint**, **Kdenlive**, or **DaVinci Resolve** (for simple video editing) - Headphones or speakers - AI-generated sounds from tools like Suno, Amper, or generated earlier - Hand-made sounds recorded in class (e.g., tapping, whispering, water pouring) - Images and visual markers from previous lesson - USBs or cloud folders for saving projects - Optional: printed guide with basic commands for Audacity and chosen video tool

Description of Specific Activities	**Step**	**Description of the activities**	**Duration**
	Feel:	The class begins by revisiting some of the group's marker sketches and music concepts from the previous lesson. The teacher invites students to listen to a short 30-second clip created with mixed sound sources—some from AI (like a Suno-generated melody), others from recorded classroom noises (like fingers snapping or paper rustling). Students close their eyes	10 min

		and imagine a scene. Then, the teacher plays the same sounds paired with an image or short video. Students are asked: "How does it feel when the sound and image go together? Does it feel more real or more like a dream?" This opens a conversation about the emotional power of syncing sound with visuals and sets the mood for creating their own sonoscape.	
	Imagine:	Students return to their groups and revisit their visual marker and story concept from the last session. They are reminded that the next step in their immersive design is to bring that marker to life through sound. Each group begins to imagine what their **augmented sonoscape** will sound like—what is the first thing a user hears? Is it soft? Is there a voice, a melody, or a beat? Does the sound evolve gradually or switch suddenly? Students discuss how their image and concept can be translated into musical form, combining both AI-generated sounds and handmade recordings. They decide on the mood or story their soundtrack will express and list the sound elements they want to include—such as rhythm, natural sounds, digital instruments, or voice.	10 min
	Create:	Now groups begin crafting their sonoscape. Using **Audacity** (or another accessible DAW), they layer together different types of sound. This includes: • **Hand-crafted audio**: such as their own voice, percussion using pencils or tapping, or environmental recordings from earlier lessons. • **AI-generated audio**: clips created previously using tools like Suno or generated in real-time with teacher guidance. Students learn how to import these sounds, trim unwanted parts, fade audio in or out, and adjust volume to blend layers. The teacher demonstrates how to create basic rhythm or ambient texture using loops. Groups structure their final soundscape to be around 30–60 seconds long and plan a	25 min

		beginning, middle, and end—just like a short story. Once the sound design is complete, the students move on to syncing it with visuals. Using **PowerPoint, Kdenlive, or DaVinci Resolve** (depending on access), they insert their previously designed marker or related visuals (photos, digital art, or slides). They then place their sound under the visual sequence, aligning key image changes or animations with beats or audio shifts. The teacher supports students in aligning visuals to sound cues (e.g., an image appears as a sound begins). This process helps students understand the relationship between audio and visual timing.	
	Share:	Each group presents their marker sketch and user flow to the rest of the class. They describe the experience they want the user to have, what they see when the marker is scanned, what kind of music or sound begins, and how the emotional tone changes throughout the soundscape. They explain how their image and their music work together. For example, a group with a spiral-shaped marker might say, "We chose this shape because it reminds us of a whirlpool, and our sound gets more intense like spinning water." As other students listen, they give feedback like, "That part sounded magical," or "I think the music fit the story really well." This stage helps students reflect on how effectively their ideas connect visuals, sound, and emotion and how the user might experience the result.	15 min
Follow up activities (if needed)	- Students will revise their sonoscapes and visual design based on peer and teacher feedback - Focus on tightening the transitions, adjusting volume levels, and making sure their sonic landscape clearly communicates the intended story or mood - Begin to prepare a simple presentation that explains their creative choices for the final exhibition or digital showcase		
Assessment / Reflection / Feedback	- **Formative feedback** is provided through peer sharing and class discussion. - Students complete a short **self-reflection sheet** at the end of the lesson, answering prompts such as: o What sounds worked best for your story?		

	○ What was difficult about syncing the audio and visuals? ○ What do you want to change next time? - The teacher assesses: ○ **Technical understanding** (basic audio layering and syncing), ○ **Creative intent** (do the sound choices match the visual story?), ○ **Team collaboration** (equal participation and communication), ○ and **reflection depth** (ability to analyze their own work constructively).
List of Educational Material (presentations, videos, reading material, exercises/worksheets, references)	- Sample multimedia clips showing how music changes visual storytelling - Free sound effects or loops (from freesound.org or YouTube Audio Library) - AI tools (Amper, Suno) or teacher-provided audio clips - Printed storyboards and sketches from previous session - Laptops or tablets with headphones and editing software - Student worksheet for planning and reflection

4.3.2 Lesson Plan 2

Title	AR/VR preparation: Bringing the augmented sonoscape to life
Duration	1 hour
Specific Learning Objectives	The students will be able to: - Finalize their visual "marker" design that will be scanned in an AR/VR setting. - Explain how to generate a QR code that links directly to their audiovisual project. - Identify the importance of usability and flow in immersive experiences by testing their marker and media on a smartphone. - Troubleshoot technical and design issues as part of preparing a media project for a public showcase.
Key STEAM Elements	**Science** (understanding how light, image recognition, and sound behave in digital displays), **Technology** (using tools such as QR code generators, video hosting platforms e.g., Google Drive, YouTube, and smartphones for testing interactive experiences), **Engineering** (ensuring smooth functionality and system flow in the AR experience), **Arts** (refining the design of the visual

<table>
<tr><td></td><td colspan="3">marker and synchronizing music with meaning) and Mathematics (spatial and proportional thinking in marker design and QR placement).</td></tr>
<tr><td>SDG/ Sustainability / Cultural Heritage Focus</td><td colspan="3">Students use accessible digital tools to prototype and test creative media experiences. The immersive experiences can include themes related to local culture, nature, or environment, inviting reflection through technology-enhanced storytelling.</td></tr>
<tr><td>Materials / Resources Needed</td><td colspan="3">- Laptops or tablets with:
✓ Access to their completed audiovisual files (videos with synced music and visuals)
✓ Access to free online QR code generators (e.g., www.qr-code-generator.com)
✓ A simple image editing tool (Canva, Google Drawings, or even paper)
- Smartphones or tablets with QR code scanners
- Printed templates or blank sheets for visual marker design
- Headphones or speakers for sound clarity testing
- Stable internet connection for file sharing</td></tr>
<tr><td rowspan="3">Description of Specific Activities</td><td>Step</td><td>Description of the activities</td><td>Duration</td></tr>
<tr><td>Feel:</td><td>The lesson begins with a class conversation where students are asked to recall what parts of their audiovisual experience were most impactful. The teacher asks: “How will someone else experience your work?” and “What would you want them to feel when they scan your design?” To inspire them, the teacher shows a working example of an AR marker: a printed drawing that, when scanned with a phone, plays a layered audiovisual piece (e.g., a landscape image that launches calm ambient music and a short video). Students are asked to reflect on what made the example successful. Did the sound match the visuals? Was the QR code easy to scan? Was the design inviting?</td><td>10 min</td></tr>
<tr><td>Imagine:</td><td>In their groups, students begin planning the final design of their printed visual “marker.” This marker will serve as both a piece of visual art and a functional access point to their digital soundscape. Students consider the size, colors, and placement of their QR code, ensuring it is visible but doesn’t distract from the artwork. The teacher helps students sketch their layout, encouraging them to ask: “Does the image hint at what the sound will be like?” or “How will someone feel when they scan this?” Students imagine themselves as users seeing it for the first time.</td><td>10 min</td></tr>
</table>

<table>
<tr><td rowspan="2"></td><td>Create:</td><td>Students now get hands-on with the tools. First, they upload their completed video (from the previous lesson) to a file-sharing or video platform like Google Drive or YouTube (unlisted link). They copy the video link and paste it into a QR code generator, customizing the design if desired. Once the QR code is generated, they download and insert it into their marker layout (using Canva, Google Slides, or simply glueing a printout onto their drawing). After finalizing the graphic design, they print or prepare the marker for testing. Each group checks their sound, video sync, and QR responsiveness.</td><td>25 min</td></tr>
<tr><td>Share:</td><td>Each group conducts a live test of their project: they display their printed marker and scan it with a phone to make sure the QR code works correctly. They ensure the music plays clearly, the image resolution is strong, and the overall experience reflects their creative goal. After testing, the groups rotate to try each other's experiences. They provide peer feedback: Was it easy to access? Did the music fit? Was the design clear and exciting? The teacher facilitates a wrap-up discussion where students share what they learned about connecting physical and digital creativity.</td><td>15 min</td></tr>
<tr><td>Follow up activities (if needed)</td><td colspan="3">Students will prepare for a mini-exhibition or demo day, where their immersive audiovisual experiences can be displayed to classmates, families, or the school community
Finalize any visual or technical refinements based on test results and feedback</td></tr>
<tr><td>Assessment / Reflection / Feedback</td><td colspan="3">Peer feedback is collected informally during the test-and-try session. Students take notes on what worked and what they may need to revise.
A student reflection sheet asks:
✓ Was your experience easy to access?
✓ What part are you most proud of?
✓ What would you improve?
The teacher evaluates:
✓ Functionality of the experience (QR code works, audio is clear, visuals are visible),
✓ Creativity and connection between sound and design,
✓ Collaboration and problem-solving during creation,
✓ Engagement and reflection during peer sharing.</td></tr>
</table>

List of Educational Material (presentations, videos, reading material, exercises/worksheets, references)	- QR code generator websites (e.g., www.qr-code-generator.com) - Online hosting platforms (YouTube, Google Drive) - Digital art tools (Canva, Google Drawings) or printed drawing materials - Smartphones/tablets with cameras and internet access - Sample working AR markers

4.3.3 Lesson Plan 3

Title	Vernissage and feedback: Presenting the augmented sonoscape
Duration	1 hour
Specific Learning Objectives	The students will be able to: - Organize and present their audiovisual, AI-enhanced, and AR-linked creations in a simple public-facing setup. - Communicate the process behind their artistic decisions, including data selection, sound design, and technological tools used. - Participate in constructive feedback by giving and receiving insights about the effectiveness and creativity of each other's projects. - Reflect on how art, science, and technology can work together to tell stories and provoke emotions.
Key STEAM Elements	**Science** (understanding and communicating data used to inform sound design), **Technology** (using digital tools to express creative ideas), **Engineering** (ensuring that visual/audio content works through technical setup, connection, and access), **Arts** (curating and performing an original immersive sound experience) **and Mathematics** (presenting patterns or structures from datasets and sound mapping strategies).
SDG/ Sustainability / Cultural Heritage Focus	- Promoting interdisciplinary learning through a real-world style presentation and reflection. - Students use innovation to turn abstract data into expressive audiovisual art. - Emphasis on teamwork, collaboration, and constructive peer dialogue.
Materials / Resources Needed	- Student-completed projects (QR-linked videos, physical markers, visuals, and accompanying music) - Smartphones or tablets with QR code scanning and internet access - Printed or digital presentation cards for each group (project title, data theme, sound style, tools used) - Headphones or external speakers for each station - Space for students to set up their stations—tables, walls, or desk areas

	- Reflection sheets or feedback forms (paper or digital)		
Description of Specific Activities	**Step**	**Description of the activities**	**Duration**
	Feel:	The session opens with excitement as students arrive to transform their classroom into a mini exhibition space or *vernissage*. The teacher invites students to think of their station as a "tiny museum room" or "tech gallery." They are asked: "What do you want people to feel when they walk by your station?" Students think back to their process and identify a word that best describes their work (e.g., "mystery," "peace," "power"). This sets the tone and reminds them that their project is more than just a technical product—it's an emotional and intellectual experience.	10 min
	Imagine:	Each group prepares their **station setup**, placing their printed marker visibly on the table or wall, ensuring the QR code is functional, and testing their audio setup with headphones or small speakers. Students decorate their space minimally if time allows, choosing colors or symbols that represent their project's theme. As they get ready, the teacher asks guiding questions: "How will you introduce your work?" and "What part are you most proud of?" This helps students mentally rehearse their explanations and get into the mindset of artists sharing a message with the world.	10 min
	Create:	One by one, groups take turns presenting their **3–5 minute talk** to the class (or rotating mini-audiences). Each group explains their process: • What data they selected (e.g., temperature, plant growth, historical events) • How they transformed that data into **sound**, using both handmade and AI-generated tools • How they designed their **AR/VR marker**, and how the audiovisual experience was meant to feel As they speak, the group plays their sound or video, using their marker or QR code. Classmates listen and engage, sometimes scanning or	25 min

		interacting with the project themselves. The teacher may assist groups with timing and transitions between presentations. | 25 min | | **Share** | After all groups have presented, the class gathers in a large circle for a **closing reflection and feedback session**. The teacher guides the discussion with thoughtful prompts: • "Which project surprised you the most, and why?" • "How did sound help you understand the data theme?" • "What was hard about making this experience work?" • "How do you think artists and scientists can collaborate in the future?" Students are encouraged to give compliments, offer gentle suggestions, and reflect on what they learned from their peers. As a final activity, students complete a short reflection form or drawing showing what they learned from the whole unit.	
	Share:	Each group conducts a **live test** of their project: they display their printed marker and scan it with a phone to make sure the QR code works correctly. They ensure the music plays clearly, the image resolution is strong, and the overall experience reflects their creative goal. After testing, the groups rotate to try each other's experiences. They provide peer feedback: Was it easy to access? Did the music fit? Was the design clear and exciting? The teacher facilitates a wrap-up discussion where students share what they learned about connecting physical and digital creativity.	15 min
Follow up activities (if needed)	- Host a **family open house** or **school showcase**, where students can present their projects to parents, teachers, or younger classes. - Invite students to **document their journey** in a short creative journal entry, poster, or video. - Optionally, compile all student creations into a **digital class gallery** (e.g., a Padlet wall or class Google Site).		

Assessment / Reflection / Feedback	- Presentation Assessment: The teacher uses a simple rubric during group presentations based on clarity, creativity, explanation of tools, and confidence. - Peer Feedback: Students give 2 stars and 1 wish for each project they visit ("I liked..., I liked..., I wish..."). - Self-Reflection: Each student fills out a reflection sheet with the following questions: ✓ What part of your project are you most proud of? ✓ What did you learn about music, data, or technology? ✓ How would you improve your project if you had one more day? ✓ Do you think your sound helped tell a story?
List of Educational Material (presentations, videos, reading material, exercises/worksheets, references)	**4.3.4 All student-created materials: QR-linked audiovisual files, printed AR markers, accompanying music** - Smartphone/tablet setup with QR reader - Printed presentation templates for student stations - Headphones or speakers - Basic decor (optional) for display spaces - Reflection and feedback forms (printed or digital) - Access to previously used software (Audacity, QR generator, Canva, etc.)

Module 2

Learning STEAM through Music

(Part 2)

Co-funded by the European Union

Funded by the European Union through the CREATIVE EUROPE Programme. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or European Education and Culture Executive Agency (EACEA). Neither the European Union nor the granting authority can be held responsible for them.

Project n°: 101173445 — CREA-CULT-2024-COOP

Our project partners:

Author(s): Mario Spada, Paolo Clemente, Fabrizio Festa, Annamaria Guarino

Institution(s): Materahub

Date: August 2025

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Commission. Neither the European Union nor the granting authority can be held responsible for them.

Table of contents

1 Introduction

1.1 Purpose of the document

This document collects a set of modular lesson plans developed within the STEAM Innovation framework, focusing on **music, sound, and immersive technologies**. The aim is to provide teachers with ready-to-use pathways where artistic exploration and scientific inquiry meet, encouraging students to experience sound not only as entertainment but also as a medium for research, design, and expression.

Each module integrates the **Design Thinking approach** (Feel, Imagine, Create, Share), guiding students step by step through inquiry, experimentation, and reflection. By engaging with tools for sound analysis, generative AI, and augmented reality, learners are invited to transform everyday listening into creative problem-solving and collaborative projects.

The lesson plans are conceived as flexible units: teachers may choose single activities or combine them into a broader sequence. Together, they open a pathway where students:

- learn how sound works from both scientific and artistic perspectives;
- design and prototype augmented soundscapes that connect digital innovation with cultural heritage and sustainability;
- cultivate transversal skills such as creativity, critical thinking, and teamwork;
- discover how emerging technologies (AI, AR/VR) can be used responsibly to tell stories and engage communities.

The final purpose of this collection is to empower young learners to feel like active creators of meaning and culture, capable of designing experiences that bridge science and art, technology and imagination, school and community.

2 Module Description

2.1 Introduction

This module offers a compact, modular pathway of three 4-hour lesson plans that centre sound and music within STEAM education. Grounded in the maker ethos of "learning by doing", the module emphasises creative reuse of available resources and a hands-on pedagogy that develops scientific understanding (acoustics, data interpretation), digital craftsmanship (sound synthesis, DAW editing), and artistic practice (sonification, sound art, audiovisual design). Lessons follow a design-thinking sequence (Feel - Imagine - Create - Share) and culminate in a public presentation or vernissage where students exhibit interactive audio-visual works triggered by simple AR/QR markers.

The activities are intentionally low-cost and adaptable: they require common school devices (smartphones, laptops/tablets), free or demo software (Chrome Music Lab, Beepbox, Audacity, Melobytes), and encourage students to draw on local data and sounds to make the work contextually meaningful. The module fosters creativity, resilience, collaboration and community engagement, positioning students as active creators and responsible users of contemporary media technologies.

2.2 Learning objectives

By the end of the module learners will be able to:

- Explain core acoustic concepts (frequency/pitch, amplitude/loudness, timbre) and demonstrate them practically.
- Collect, curate and critically evaluate simple datasets and field recordings suitable for sonification.
- Design and implement clear data-to-sound mappings and produce basic sonifications that communicate information and meaning.
- Operate entry-level digital audio tools to synthesize, record and edit sound; combine recorded, synthesized and AI-generated audio.
- Produce visual assets with generative tools and integrate them into synchronized audiovisual segments.
- Design a basic interactive user flow (e.g., AR/QR marker - triggered audio-visual playback) and test it on mobile devices.
- Reflect on ethical issues related to generative AI, authorship and sustainability; present and justify creative and technical choices to peers and community audiences.

Competence development includes scientific literacy, computational thinking, digital media skills, creative expression and civic engagement.

2.3 Available partnership opportunitie

The module supports multiple partnership models. Suggested stakeholders and their possible contributions:

- **Parents & Families** - Skills and material support (field recordings contributed from home, local stories/datasets), attendance at vernissage events.
- **Local music schools / conservatories / university music departments** - Guest workshops on sound design, instrument demonstrations, mentoring and assessment support.
- **Cultural heritage institutions & museums** - Access to archival audio, site-specific recordings, co-curation of soundwalks and exhibition hosting.
- **Environmental organisations & citizen science groups** - Provision of local environmental datasets (weather, biodiversity), joint recording expeditions and contextual expertise.
- **Creative tech companies / AI labs** - Technical demonstrations, mentorship, temporary access to cloud tools or advanced models for class use.
- **Community radio stations / arts centres** - Platforms for broadcasting student works, venue support for vernissage and public engagement.
- **Local artists / sound artists** - Co-creation opportunities, critique sessions, residency-style mentoring to raise artistic standards.
- **Schools of visual art / media labs** - Collaboration on image generation, video editing and exhibition design.
- **Local authorities / municipalities** - Support with permissions for outdoor soundwalks, showcasing student outcomes in public spaces.

  Partnerships can be structured as single workshops, recurring mentoring, resource loans (hardware / software), data-sharing agreements, or hosting of the final exhibition.

2.4 Recommended resources

Software & web tools (classroom-friendly):

- Chrome Music Lab (Oscillators, Spectrogram)
- Beepbox

- Audacity (free) and introductory workflows for Ableton Live (where available)
- Melobytes (image-sound) and demo access to image-generation tools (DALL.E / Midjourney / Stable Diffusion)
- Simple AR/QR platforms: Artivive, Zappar, or QR code + web-hosted playback solution

Hardware & classroom supplies:

- Laptops/tablets (1 per small group) and smartphones for recording/AR testing
- Headphones, portable speakers, external mics (clip-on mics recommended but optional)
- Printed worksheets, storyboard templates, and markers for physical prototyping

Pedagogical materials:

- Worksheets: “Data-Sound Mapping”, “Interaction Flowchart”, vernissage checklist
- Curated audio examples (sound art excerpts, sonification demos) and teacher guidance on ethical AI use

Low-cost / no-equipment alternatives:

- Classroom objects for acoustic demonstrations (rubber bands, cups, bottles)
- Smartphone recordings in place of dedicated microphones
- Cardboard and craft materials for marker/design prototyping

Datasets & content sources:

- Locally gathered environmental measures (school garden, weather station)
- Field recordings from soundwalks, community-contributed audio, open environmental datasets

2.5 Age of students involved

11 - 18

2.6 Subject domain

Primary domains: Music & Sound Art, Physics (Acoustics), Digital Media / ICT.

Cross-curricular links: Computer Science (data mapping, computational thinking), Visual Arts (image-making, editing), Environmental Science (local data collection, fieldwork), Ethics/Media Literacy (AI authorship, bias, sustainability), and Language (presentation and documentation skills).

3 Implementing the Module following the Design Thinking Approach

FEEL *What is the problem demanding action from the schools*	**Phase I - Question** This initial phase frames the project around an audio-centred theme that will guide students through inquiry, listening and creative investigation. Teachers introduce a context that is meaningful to students (local environment, cultural memory, school life, climate/weather patterns, biodiversity or community stories) and motivate them through evocative sound examples, short soundwalks or listening sessions. The aim is to open curiosity and encourage pupils to pose investigable questions such as: Which local sounds matter to us? What information could be expressed through sound? Which community stories are missing from our school soundscape? Students formulate hypotheses and questions they can test by listening, recording and collecting data. Encourage them to link scientific curiosity (how sound behaves) with artistic inquiry (what sounds express) so they imagine solutions that are both informative and expressive. **Suggested teacher actions & prompts** ● Kick off with a short soundwalk or curated audio examples (sound art excerpts, environmental recordings). ● Ask students to journal first impressions: Which sounds surprised you? Which sounds tell a story? ● Prompt question generation: "How might we help our community notice changes in local air quality through sound?" or "How might we preserve local oral stories through interactive sonification?" **Phase II - Evidence** Students gather empirical material that will inform later sonification and design choices. Evidence-gathering for a sound project emphasises listening and data collection: **Data collection methods** ● Field recordings (smartphone or portable mic): locations, timestamps and short context notes. ● Environmental datasets (temperature, rainfall, plant growth, school pedestrian counts) - collected by students or provided by partners. ● Interviews & oral histories recorded with permission (family, neighbours, local elders).

	● Observational logs and empathy maps focused on how people use public spaces and what sounds accompany daily life. **Tools and templates** ● Field notebook templates (time, location, microphone used, description). ● Simple metadata forms for recordings (who, where, why). ● Google Forms for quick community surveys about perceptions of local soundscapes. ● Teacher-led mini-lessons on ethical recording (consent, privacy) and basic recording technique. Collecting evidence transforms assumptions into documented material on which sonification and artistic interventions can be based.
IMAGINE *How could the schools – students act up?* *What partnerships are required?*	**Phase III - Analyse** Students synthesise evidence to become domain experts: listening back to recordings, visualising datasets, and identifying patterns that suggest interesting mappings or narratives. This analysis phase fuels creativity. **Activities** ● Listening sessions with guided note-taking: identify motifs, recurring events, unusual sounds. ● Data exploration: plot time-series (temperature vs. noise level), identify correlations to inspire mapping rules. ● Stakeholder mapping: who benefits from a sound-based intervention (students, elderly neighbours, park visitors)? ● Ideation workshops using "How might we…" prompts focused on sonic outcomes (awareness-raising sonification, immersive audio tours, interactive story-players). **Suggested thinking tools** ● Problem trees and root-cause diagrams to find where sound interventions can have impact.

	- SWOT on proposed audio projects (feasibility vs. expressive potential). - Rapid sketching of interaction flows (marker - playback - extra info). **Phase IV - Explain** Students select ideas and articulate a clear project brief: target audience, intended impact, core sonic assets, required partners and resources, and success criteria. **Outputs** - A concise project brief per group: goal, target users, dataset/recording sources, proposed sonification rules, and interaction design (how will users trigger and navigate the experience?). - Identification of partnership needs (local museum for archival audio, environmental NGO for datasets, music teacher for sound-design mentoring, community centre for vernissage). Example brief excerpt: "We will design an Augmented Soundwalk that sonifies hourly temperature changes as melodic contours and overlays community memories at key waypoints. We partner with the municipal library for archival recordings and the local maker space for QR marker printing."
CREATE *Describe the activities*	**Phase V - Connect** Students move from concept to production. Emphasise iterative prototyping: quick mock-ups, tests on devices, and controlled iteration. **Planning & project management** - Define roles (recorder/editor/designer/presenter), timeline and materials. - Create an interaction flowchart: marker locations, playback length, fallback if no network. **Core creation activities** **Field recording & sound gathering:** capture environmental sounds, interviews and classroom sound effects. Teach basic mic technique and metadata tagging.

	• **Data-to-sound mapping (sonification):** choose mappings (e.g., pitch - temperature, duration - event frequency, timbre - pollutant type) and document mapping rules on worksheets. • **Sound synthesis & editing:** use Chrome Music Lab, Beepbox or Online Sequencer to prototype melodies; use Audacity (or Ableton where available) to edit, layer and mix recorded and synthesized material. • **AI-assisted asset generation:** create complementary images with generative image tools and optionally convert them into audio textures with Melobytes for palette expansion (with a guided ethical discussion). • **AR/QR integration:** design graphic markers, generate QR codes or use Artivive/Zappar workflows to tie markers to hosted audio-visual files. Test playback on a range of devices. • **Prototyping & testing:** run small user-tests with peers and community partners, collect feedback, refine mapping choices and interaction timing. **Maker-minded alternatives** • If advanced hardware is unavailable, create cardboard mock-ups of marker stations, use pre-recorded audio files on students' phones or a simple web page that plays the synchronized media. **Example outputs** • Short sonified sequences representing a dataset (e.g., a 2-minute sonification of daily temperature across a week). • An AR-enabled schoolyard station that plays a layered audio piece when scanned, combining a field recording and a sonified dataset. • A storyboard and interaction map for the final vernissage.
SHARE *How do you plan to share the outcomes of your activities and build new partnerships?*	**Phase VI - Communication** The share phase is the public-facing culmination. Plan dissemination and stakeholder engagement early so the final event has maximum impact. **Sharing formats** • **School vernissage / Augmented Soundscape exhibition:** set up physical stations (markers, headphones, explanatory panels) and invite parents, local partners, and community groups.

	● **Soundwalks:** guided routes where groups lead visitors and explain sonification choices. ● **Broadcast & online:** upload short mixes or project videos to the school site or community radio; create a simple web gallery with sound clips, visual assets and project documentation. ● **Workshops & partner presentations:** invite partner organisations to trial the stations and discuss possible continuations (e.g., installation in a public park). **Outreach & documentation** ● Create short explainers: project poster, one-page program for the vernissage, and a QR-enabled gallery linking to deeper content. ● Use photos and short video clips for school newsletters and social media (with permissions). ● Encourage students to prepare a 3–5 minute presentation covering concept, data choices, mapping rationale, and ethical reflections. **Engaging partners** ● Invite partners to judge or mentor during the vernissage, to support continuity and potential scaling of successful projects. **Phase VII – Reflection** Reflection consolidates learning and supports metacognitive growth. **Reflection activities** ● Group debrief: What worked, what failed, what surprised us? Tie technical outcomes to learning objectives (science, computational thinking, artistic intent). ● Personal reflection journals or video diaries describing individual contributions and learning points. ● Peer feedback sessions guided by rubrics (artistic conceptualization, sonification clarity, integration of visuals, interaction quality, teamwork). ● Partner feedback: invite community partners to provide formative feedback and potential next-step suggestions.

	● Plan sustainability: how can the project persist (hosted audio on school servers, annual soundwalks, integration into local festivals)? ● Celebrate achievements publicly and reflect on ethical considerations and the role of AI in creative practice. Ensure students feel ownership and pride in their work.

4 Description of the Lesson Plans in the Module

4.1 Introduction

- Lesson Plan 1 - Sound as Art and Science: From Physics to Creative Expression
- Lesson Plan 2 - AI and Immersive Worlds: Designing the Augmented Soundscape
- Lesson Plan 3 - Bringing life: the Augmented Soundscape

4.2 Lesson Plan 1

Title	Sound as Art and Science: From Physics to Creative Expression
Duration	4 hours
Specific Learning Objectives	The students will be able to: • Explain the physical properties of sound (frequency, amplitude, timbre) and how we perceive them • Recognize sound's artistic potential through examples of Sound Art • Use basic digital tools to synthesize sounds • Map simple datasets into sonic sequences • Start conceptualizing a final "Augmented Soundscape" project • Describe one example of how a dataset can be translated into a musical parameter (e.g., higher temperature - higher pitch). • Reflect critically on the social and ethical implications of recording and sharing community sounds. • Explain at least one way sonification can increase accessibility (e.g., turning graphs into sound for visually impaired listeners). These expansions connect the lesson to SDG 4 (education & musical literacy) and SDG 10 (reducing inequalities through accessible sonification).
Key STEAM Elements	Science (acoustics, data interpretation), Technology (digital sound tools), Arts (sound art, creative expression).
SDG/ Sustainability / Cultural Heritage Focus	Promoting creative interpretation of scientific data to foster environmental awareness. **SDG 4 - Quality Education:** activities scaffold musical literacy (listening, naming elements of sound, using digital composition tools) and encourage inclusive participation.

<table>
<tr>
<td></td>
<td>

SDG 10 - Reduced Inequalities: include sonification practices that offer alternate (non-visual) ways to access data and artistic works.

SDG 11 - Sustainable Communities: encourage documentation and preservation of local soundscapes and oral histories.

SDG 13 - Climate Action: offer dataset options that include environmental data (temperature, rainfall, phenology) so students can convert climate data into musical narratives.

</td>
</tr>
<tr>
<td>Materials / Resources Needed</td>
<td>

- Sound art examples (John Cage, Bill Fontana)
- Chrome Music Lab (Oscillators, Spectrogram).
- Beepbox
- Audacity or Ableton Live
- Worksheets for data-to-sound mapping and project brainstorming
- Example datasets (temperature readings, lunar cycles, plant growth)
- Smartphones or simple recorders for follow-up soundwalks
- Headphones for focused listening

</td>
</tr>
<tr>
<td>Description of Specific Activities</td>
<td>
<table>
<tr>
<th>Step</th>
<th>Description of the activities</th>
<th>Duration</th>
</tr>
<tr>
<td>Feel:</td>
<td>

Discussion: What makes a sound “art”? Listen to short excerpts from John Cage, Bill Fontana, and others. Students reflect on their emotional responses and how the works challenge traditional ideas of music.

1. **Setup (2 min):** Teacher briefly introduces sound art (1–2 sentences) and explains the listening protocol (quiet, notes, no interruptions).

2. **Listening (8 min):** Play two short excerpts (30–90s each) - choose contrasting works (e.g., a minimal Cage excerpt and a Bill Fontana environmental installation snippet).

</td>
<td>20 min</td>
</tr>
</table>
</td>
</tr>
</table>

		Ask students to listen for 60 seconds, then pause. 3. **Immediate response (4 min):** Students write three words that describe how the excerpt made them feel and one question that arose. This supports SDG4 by practicing musical vocabulary. 4. **Pair-share (4 min):** Students compare words in pairs and then share one observation with the class. Teacher records notable points on the board (emotional reactions, surprising sounds, questions about origin). 5. **Teacher prompt (1-2 min):** Ask: *Which parts felt like 'music' and which felt like 'environment'?* This opens dialogue about blurring art/science boundaries.	
	Imagine:	Interactive lecture on sound science (vibration, frequency, amplitude, timbre). Use classroom objects to demonstrate wave behavior. Students visualize sound using Chrome Music Lab. 1. **Mini-lecture (10 min):** Use simple language and demonstrations to define: vibration, frequency (pitch), amplitude (loudness), timbre (tone color). Show quick diagrams and short audio examples for each property. 2. **Hands-on demos (10 min):** Demonstrate with classroom objects: rubber band stretched and plucked (timbre/frequency), glass with water (pitch change), tuning fork touching a table (vibration). Ask students to predict what will happen before each demo	40 min

		(engages scientific thinking). 3. **Chrome Music Lab exploration (15 min):** - Provide short guided tasks (worksheet prompts): "Open Oscillators, set a low frequency and then a high one - note how the sound changes. Open Spectrogram and sing a short sound into the mic - observe the frequency bands." - Students work in pairs. Teacher circulates to scaffold and correct misconceptions. 4. **Reflection (5 min):** Quick plenary: each pair shares one thing they discovered about sound properties and one idea for how these properties might map to data (e.g., frequency = temperature). **Differentiation:** Provide extension prompts for advanced students (e.g., explore harmonic spectra in Chrome Music Lab) and simplified tasks for younger/less-experienced learners (compare two pitches and name higher/lower).	
	Create:	In groups, use Online Sequencer or Beepbox to map a simple dataset (e.g., temperatures) into a sound sequence. Students decide mapping rules (pitch = temperature, duration = time, etc.) and record output in Audacity or Ableton Live. Groups choose a dataset theme for the final "Augmented Sonoscape". **Preparation (10 min):** ● Teacher explains the concept of **data-to-sound mapping** and shows a brief example: a small spreadsheet of 7 daily	90 min

		temperatures mapped to 7 pitches. Provide the "Data-Sound Mapping" worksheet with mapping suggestions and examples (pitch mapping, velocity/loudness, stereo position, timbre selection, rhythm/duration). Link mappings to SDG13 by offering climate datasets (daily temperature or rainfall) as options. **Group planning (15 min):** ● Each group (3-4 students) chooses a dataset: options include schoolyard temperature, week of rainfall, daily count of birds in the garden, students' step-count averages, or a culturally meaningful dataset (dates of local festivals). ● On the worksheet they: - record dataset source and units, - draft mapping rules (e.g., pitch = normalized temperature 0-127 MIDI), - decide instrumentation (sine wave for climate trend, sampled field sound for local identity). - set roles (data mapper, sequencer, editor, documenter). **Prototyping in Beepbox (40 min):** ● Groups input mapped values into the sequencer: convert numeric values to note values (teacher provides quick reference table), assign instruments, and layer simple harmony or accompaniment if time allows.	

		● Save/export a short audio file (30-90s). ● Teacher circulates to check mapping logic and offer technical tips. **Editing & polish in Audacity/Ableton (20 min):** ● Import sequences and add recorded environmental samples if available (e.g., short schoolyard clip). ● Basic mixing: trim, fade-in/out, normalize levels. Export final group clip. **Accessibility & inclusion (throughout):** ● Provide sonification alternatives for visually oriented datasets (e.g., provide both a plotted graph and a sonified clip). This addresses SDG10 - help students understand how sound can convey quantitative information for diverse audiences. ● Offer headphones and quiet spaces for students sensitive to noise. **Deliverables:** ● One exported audio file per group (labelled with group name and dataset). ● Completed "Data-Sound Mapping" worksheet documenting mapping choices and rationale. ● Short note on SDG relevance (e.g., "We sonified temperature to highlight climate trends" - links to SDG13).	

	Share:	Groups present their short sequences to the class, explaining their mapping choices. Peer feedback focuses on creativity and clarity of data-sonification link. Groups draft a concept for the final "Augmentes Sonoscape". 1. **Setup (5 min):** Arrange listening stations or present sequentially. Ensure good audio playback (speakers/headphones). 2. **Group presentation (5 min per group):** Each group: - plays their 30-90s clip, - presents mapping rules (1 slide or poster), - explains dataset source and any ethical considerations (e.g., consent for recordings), - states which SDG(s) their work engages (choose from 4, 10, 11, 13) and why. 3. **Peer feedback (3 min per group):** Peers use a simple sheet: *1 Praise (what worked well), 1 Question (what they'd like clarified), 1 Suggestion (next step).* This keeps feedback constructive and actionable. 4. **Group reflection (5 min):** Each presenting group quickly notes one change they will make based on feedback - feed-forward approach. 5. **Concept draft for final Augmented Soundscape (10-15**	90 min

			min): Groups use feedback to write a short concept: where would this sonification sit in a public soundwalk or AR-triggered station? Which partner (library, environment NGO) could support it? This links to SDG11 (cultural soundscape preservation & community sharing).	
Follow up activities (if needed)	• Conduct a sound walk to collect environmental sounds (field recording protocol and consent). • Bring a personal dataset from home to experiment with. • Optional: invite a local partner (museum, radio) to a listening session.			
Assessment / Reflection / Feedback	• Teacher observation of participation in discussions and group work • Review of each group's mapped sound sequence • Peer feedback session **Reflection prompts:** • What did we learn about the relationship between data and sound? • How could sonification help people who don't read graphs (SDG10)? • Which aspect of our local soundscape should be preserved (SDG11)? • How did our project reflect environmental data or climate concerns (SDG13)?			
List of Educational Material (presentations, videos, reading material, exercises/worksheets, references)	Audio clips: John Cage, Bill Fontana examples (also include brief contextual notes on each clip) John Cage: 4'33'' / Petrenko · Berliner Philharmoniker Bill Fontana - Landscape Sculpture With Fog Horns: Installation Vers...			

	Web pages and Tutorials, adding step-by-step mini-guides for students. **Chrome Music Lab** Chrome Music Lab BLINDING LIGHTS on Chrome Music Lab **Beepbox** BeepBox Lets Make A Music (With Beepbox) **Audacity** Audacity Audacity Step by Step Tutorial for Beginners - 2025 **Ableton Live** Try Ableton Live 12 for free – 30-day Trial download

4.3 Lesson Plan 2

Title	AI and Immersive Worlds: Designing the Augmented Soundscape
Duration	4 hours
Specific Learning Objectives	The students will be able to: • Use generative AI to create sound and visual elements • Understand AR and VR concepts and their application in art • Design an immersive experience that integrates their soundscape • Plan interactive user experiences using visual markers and QR codes • Students will document prompts used for AI generation and reflect on authorship and bias. • Students will produce at least one AI-derived image and one AI-derived audio texture (or converted image-audio) and integrate them into a short audiovisual prototype. • Students will test the interaction on at least two different devices (smartphone/tablet) and note accessibility considerations (captions, audio levels, alternative non-visual triggers).

<table>
<tr><td>Key STEAM Elements</td><td colspan="3">Technology (AI, AR/VR), Arts (digital creativity, multimedia design), Science (data interpretation).</td></tr>
<tr><td>SDG/ Sustainability / Cultural Heritage Focus</td><td colspan="3">Exploring ethical and sustainable creative practices in AI art.

SDG 4 (Quality Education): develops digital and media literacy, introduces ethical use of AI as a creative tool.

SDG 10 (Reduced Inequality): demonstrates sonification and multimodal outputs as accessibility tools for non-visual audiences.

SDG 11 (Sustainable Communities): encourages cultural preservation by embedding local stories into AR experiences.

SDG 13 (Climate Action): supports converting environmental datasets into expressive AI-enhanced sound/visualisations to raise awareness.</td></tr>
<tr><td>Materials / Resources Needed</td><td colspan="3">Accounts or demo access to image generators: Midjourney, DALL.E, Stable Diffusion, or free alternatives (Craiyon, Leonardo). Note: use school/demo accounts where possible.
Audio AI tools or cloud demos: Suno AI (or use Melobytes to convert images to sound textures).
Melobytes (image-sound conversion), Beepbox, Audacity or Ableton Live for integration.
AR tools: Artivive, Zappar, or WebAR services (8th Wall demo, or free QR-web audio page).
Devices: one laptop/tablet per group + at least one smartphone for AR testing, headphones, stable Wi-Fi (or pre-download assets if offline).</td></tr>
<tr><td rowspan="2">Description of Specific Activities</td><td>Step</td><td>Description of the activities</td><td>Duration</td></tr>
<tr><td>Feel:</td><td>Discussion on AI as a creative partner. Students explore examples of AI-generated art/music, reflecting on their emotional and aesthetic impact and on the implication of using trained models in an artistic environment. Introduction to AR/VR concepts and discussion on the impact of such technologies on life and arts.</td><td>30 min</td></tr>
</table>

		Intro (5 min): Brief teacher framing - what is generative AI? quick examples of AI music and images. Show 2-3 short clips (30-60s each): AI-composed music, AI image series, a short AR demo. **Guided viewing/listening (10 min):** Students watch/listen in groups and note emotional/aesthetic responses on a simple worksheet: *what surprised you? what felt creative? what felt mechanical?* **Class discussion (10 min):** Discuss implications: authorship (who owns AI output), bias (what the model may omit), and ecological costs (computational carbon footprint) - link to SDG13 by asking whether large AI models always justify their environmental cost. **Quick AR/VR primer (5 min):** teacher explains in plain terms: AR overlays digital content on the real world (via phone); VR creates an immersive virtual environment. Show short visuals of marker-triggered AR (poster - video) and QR-web audio examples.	
	Imagine:	Students generate AI images related to their dataset theme (Midjourney, DALL.E, Craiyon, Leonardo, Copilot). Ethical discussion on authorship, originality, and bias in AI art. **Define theme/dataset (10 min):** Each group confirms the dataset/theme from Lesson 1 (e.g., temperature, local oral stories, biodiversity counts). Teacher ensures datasets are appropriate for public sharing. **Prompt workshop (15 min):** Teach prompt-writing basics: subject, style, mood, color palette, context. Provide example prompts and a printed	60 min

		cheat-sheet: ● Example prompt: *"A poetic city soundscape visualising daily temperature changes: layered silhouettes of trees and thermometers, watercolor style, dusk lighting"* ● Encourage prompts that incorporate local heritage (e.g., "include traditional festival banners"). **Image generation (20 min):** Groups generate multiple images (3-6) using their assigned AI tool. They export images with filenames. If tools are rate-limited, rotate groups or use classroom hub to queue generations. **Ethics & critique (15 min):** Groups examine outputs and answer: ● Does the image misrepresent local culture? ● Could the image reproduce stereotypes or bias? ● Who might be harmed or excluded by this representation? ● What attribution / credit will we include? Teacher introduces a short checklist: attribution, license check, consent for personal images, avoiding offensive material. **Deliverables IMAGINE:** AI Prompt Log (one per group), 2-3 candidate images saved and annotated with reflections.	

		Fallback if no AI access: students sketch visual concepts on paper or use open-source image collections and annotate them.	
	Create:	Students transform AI-generated images into audio samples via Melobytes. They integrate these with previous sound work to expand their soundscape using Audacity or Ableton Live. Groups sketch their immersive experience, defining how a physical marker will trigger the audiovisual work. Creation of a basic flowchart of user interaction. **Part A - Image-Sound (Melobytes) & AI-audio (30-35 min)** 1. **Image conversion (10-15 min):** Each group uploads one chosen AI image to Melobytes (or similar) to generate a short audio texture. Encourage experimentation with settings (grain, speed, timbre) and export resulting audio. 2. **Optional AI-audio creation (10-15 min):** If available, use an AI music tool (e.g. Suno) to generate a short motif that complements the Melobytes texture. Export and label clearly. **Part B - Integration with previous soundscape (25-30 min)** 1. **Import assets into DAW (Audacity/Ableton) (15-20 min):** Combine group's Melobytes texture, previous sonification from Lesson 1, and any field recordings. Arrange a 60–90s prototype that uses the Melobytes audio as a background/texture and integrates sonified data as foreground elements.	90 min

		2. **Mixing basics (10 min):** simple fades, pan for spatial interest, add short transitions. **Part C - Interaction & Flowchart (20-25 min)** 1. **Decide trigger type:** QR code - web page with audio/video, or image marker - Artivive overlay, or NFC tag (if available). Consider accessibility: offer both QR and a short URL or on-site listening station. 2. **Technical checklist:** verify file hosting (school server or cloud), test playback on two devices, ensure headphones availability. **Accessibility & SDG10:** ensure the experience includes a non-visual access path: sonified summary, and adjustable volume. Add subtitles for any spoken content.	
	Share:	Each group presents its audio and AR/VR design concept, receiving peer and teacher feedback. 1. **Presentation structure (per group 6-8 min):** - 1 min: context and dataset chosen (link to SDG if relevant) - 2 min: show AI images and explain prompt choices & ethical reflections (AI Prompt Log) - 2 min: play 60-90s audiovisual prototype (via speakers or headphones) - 1-2 min: show interaction flowchart and explain how users will access it (QR/marker) and accessibility features	60 min

<table>
<tr>
<td></td>
<td></td>
<td>2. Peer feedback (3 min per group): classmates complete a quick form: Like / Question / Suggestion (one line each). Use this to generate prioritized improvements.

3. Teacher feedback & assessment (10 min wrap-up): teacher highlights one technical and one conceptual strength per group. Link outputs to SDGs (4, 10, 11, 13) and suggest community partners for scaling (library, local heritage centre, environmental NGO).

4. Dissemination plan (post-lesson): suggested channels: school website gallery (with short descriptions), temporary AR trail in schoolyard, local radio feature, or a short exhibition evening.

Deliverables SHARE: presentation slide or poster, peer feedback sheets, dissemination checklist (hosting + partner contact).</td>
<td></td>
</tr>
<tr>
<td>Follow up activities (if needed)</td>
<td colspan="3">• Explore free AR creation platforms (Artivive, Zappar).
• Research immersive installations for inspiration.</td>
</tr>
<tr>
<td>Assessment / Reflection / Feedback</td>
<td colspan="3">• Review of AI-generated assets (audio and visuals).
• Evaluation of AR/VR design clarity and feasibility.
• Peer discussion on integration of sound, image, and interaction.

Formative reflection prompts for students:

• How did the AI outputs align with your intentions?
• What biases or limitations did you notice in generated images?
• How does the immersive design improve accessibility and community engagement?</td>
</tr>
</table>

	• What environmental considerations did you account for (eg. compute cost, local hosting)?
List of Educational Material (presentations, videos, reading material, exercises/worksheets, references)	Generative AI in Arts AI - Google Arts & Culture Video examples: AI-created music and visuals Art in the age of machine intelligence | Refik Anadol How to Use Suno AI Tutorial (FREE AI Music Generator) Melobytes Melobytes.com How to use Melobytes like a Pro - AI Music Secrets to Creating Stunning AI Images: Expert Prompts Artivive basic setup Artivive Artivive Tutorials - YouTube Worksheet: "Our AR/VR Design" Miro | Lo spazio di lavoro per l'innovazione Mixed Reality User Flows: A New Kind of Template | by Lillian Warner | Prototypr

4.4 Lesson Plan 3

Title	Bringing life: the Augmented Soundscape
Duration	4 hours
Specific Learning Objectives	The students will be able to: • Finalize their multimedia project by integrating sound, visuals, and interactivity. • Prepare and test an AR/VR-enabled experience. • Present and explain their work to an audience. • Reflect on the intersection of art, science, and technology. By the end of the session each group will submit a tested prototype (audio + visual + interaction trigger), a short presentation (3-5 min), and a reflection note linking their choices to at least one SDG (4, 10, 11, or 13).
Key STEAM Elements	Arts (sound and visual design), Technology (audio and video editing, AR, VR), Science (data-based creativity).

<table>
<tr><td>SDG/ Sustainability / Cultural Heritage Focus</td><td>Showcasing data-driven creativity as a tool for cultural and environmental awareness.

Explicit connections to:

● SDG 4 - Quality Education: improve musical literacy and public communication of data through sound.

● SDG 10 - Reduced Inequalities: design accessible outputs (sonification, text alternatives, clear navigation).

● SDG 11 - Sustainable Communities: document and present local soundscapes and cultural memories.

● SDG 13 - Climate Action: present environmental datasets (temperature, rainfall, biodiversity) as meaningful artistic narratives.</td></tr>
<tr><td>Materials / Resources Needed</td><td>● Audio: Audacity / Ableton Live (or any DAW) for final mixing.

● Video: DaVinci Resolve / Kdenlive / PowerPoint for audiovisual synchronization.

● Interactivity: QR code generator (free online), Artivive / Zappar / WebAR (optional).

● Devices: Smartphones/tablets for AR testing, laptop/workstation for editing, speakers/headphones.

● Print & display: printed markers/posters, headphones or listening stations, extension cables.

● Support docs: “Exhibition Setup Checklist”

● Hosting: cloud folder for final files or local server for offline demonstrations.</td></tr>
<tr><td>Description of Specific Activities</td><td><table>
<tr><th>Step</th><th>Description of the activities</th><th>Duration</th></tr>
<tr><td>Feel:</td><td>Short listening and viewing session of completed multimedia works (including excerpts from professional projects). Class discussion on which elements make them</td><td>15 min</td></tr>
</table></td></tr>
</table>

		engaging, to inspire the final production phase. **Select 2-3 short examples** (30-90s each) of finished multimedia/AR sound works and queue them for playback. Prefer examples that combine sonification + image + interaction. **Play & observe (6-8 min):** students listen/watch silently and take two notes: (a) one element that engaged them emotionally, (b) one technical/design choice they noticed. **Group debrief (5-6 min):** in 2-3 min pair-shares then 2-3 min plenary, gather comments on what made the pieces effective (clear navigation, strong emotional arc, good audio balance, contextual explanation). **Bridge to practice (1-2 min):** remind groups to use these elements (clarity, narrative arc, accessible entry point) when finalizing their projects.	
	Imagine:	Each group reflects on how to maximize the emotional and narrative impact of their "Augmented Soundscape." They review their storyboard and AR/VR user experience before final editing. 1. **Group quick-check (5 min):** each group re-opens their storyboard and interaction flowchart. They answer 3 focused questions: - What is the single emotional moment we want the audience to feel? - Is the dataset-to-sound mapping audible and meaningful in a short listening window? - What is the first action we want an audience member to take (scan,	15 min

		walk, press)? 2. **Micro-ideation (7 min):** groups sketch 1-2 small refinements (e.g., shorten intro, boost a sonified element, add a textual cue). Use sticky notes or digital comments for changes. 3. **Teacher check & sign-off (3 min):** teacher walks round, approves each group to start final production or suggests one focused improvement. **SDG framing:** ask groups to note which SDG their refinement supports (e.g., adding sonified explanation - SDG10 accessibility; including local oral excerpt - SDG11 cultural heritage).	
	Create:	Groups finalize their compositions integrating recorded, synthesized, and AI-generated sounds. They synchronize images and video in a chosen editing tool (DaVinci Resolve, Kdenlive, or PowerPoint or similar). They create the graphic marker and QR code, then test AR/VR functionality on multiple devices. **Part A - Final audio mix (40 min)** ● 0-5 min: open group folder, ensure all audio assets are present and labeled ● 5-25 min: import into DAW, align timing, adjust volumes, EQ problematic frequencies, add gentle fades. Keep total length to agreed duration (60-90s). ● 25-35 min: add spatialization (simple panning) and a short intro/outro for a coherent listening	150 min

		experience. ● 35-40 min: export 44.1kHz/16-bit WAV or compressed MP3 for web use. **Part B - Visual synchronization & master file (45 min)** ● 0-5 min: choose editing tool (DaVinci/Kdenlive/PowerPoint) and set project frame rate/resolution (e.g., 1920×1080, 30 fps). ● 5-30 min: import final audio and visual assets (AI images, video clips, captions). Synchronize key sonic events with visual cues (e.g., sonified temperature spike - image flash/graphic). Keep textual overlays concise. ● 30-40 min: render a short preview (MP4) and review for timing/typos. ● 40-45 min: export final MP4 (optimized for web or local playback). **Part C - Interaction trigger & hosting (25 min)** ● 0-10 min: choose trigger method: QR - web page with MP4/audio, or image marker (Artivive) that overlays video on a poster. If offline, prepare a local playback device with headphones. ● 10-20 min: create a QR code linking to a hosted file (Google Drive link set to view, or school server). Test the QR on one device. ● 20-25 min: prepare printed poster/marker (include title, short	

		instruction: “Scan to listen”, and a brief accessibility note: “Audio description available at link”). **Part D - Multi-device testing & troubleshooting (40 min)** • 0-15 min: test on at least two different devices (Android, iOS; phone, tablet) for playback, buffering, and AR marker detection. Log results in the **Testing Log** (device type, browser/app, success/failure, fix). • 15-30 min: fix common issues: reduce file size (re-encode), change host (if blocked by permissions), switch marker image for better recognition. • 30-40 min: final rehearsal of presentation with the interaction: one student scans, the media plays, a second student narrates what the audience should notice. **Fallback solutions:** if AR tools fail, offer simple QR - direct playback page or set up a listening station with laptop + headphones.	
	Share:	“Vernissage” setup (markers, stations). Each group presents its project in 3-5 minutes, covering concept, dataset, sonification choices, AI use, and AR/VR integration. A Q&A session follows, ending with a collective debrief on lessons learned and future possibilities for art-science integration. **Setup (10 min):** quickly place posters/markers around the room and test each station. Ensure signage shows order and accessibility options (e.g., “Need audio description? See teacher”). Arrange chairs for short presentations.	60 min

		Group presentations (3-5 min each): if you have 6 groups, allow 3.5 min per group + 1 min changeover; for fewer groups allow 5 min. Each presentation should include: ● 30s: concept & dataset (why chosen + SDG link) ● 60-90s: play prototype (audio/video) while audience scans/interacts if appropriate ● 30-60s: explanation of mapping & interaction and one ethical/accessibility choice made **Q&A (brief, 1-2 min per group)**: audience asks short clarifying questions. Teacher moderates to respect time. **Peer feedback & voting (10 min):** peers complete short feedback cards (Praise / Question / Suggestion) and optionally vote for categories (Most engaging narrative, Best accessibility design, Strongest SDG link). **Collective debrief (5-10 min):** teacher leads reflection linking outcomes to learning objectives and SDGs. Discuss next steps: public sharing, festival submission, archiving.	
Follow up activities (if needed)	• Document projects in a shared online gallery • Submit final works to a digital art festival or school exhibition		
Assessment / Reflection / Feedback	Final evaluation: ● **Artistic Conceptualization (25%)** - quality of idea, narrative clarity, cultural relevance (SDG11). ● **Sonification & Sound Design (25%)** - effectiveness of mapping, aesthetics, audio mix quality.		

	• **Visual & Multimedia Integration (25%)** - how well visuals and video synchronize with sound; clarity of captions and descriptive elements. • **AR/VR Interactivity (15%)** - functionality of trigger, usability and accessibility of interaction. • **Presentation & Collaboration (10%)** - clarity of presentation, teamwork, documentation. **How to score:** use 1-5 scale per criterion, then apply the weight to compute a final score out of 100 (same calculation method explained previously). Provide short formative comments (2 strengths, 2 suggestions) for each group. **Reflection prompts (for students to submit):** • Describe one major design decision and why you made it. • Which SDG(s) does your project support and how? • What accessibility choices did you implement? Were they effective? • What would you change if you had more time?
List of Educational Material (presentations, videos, reading material, exercises/worksheets, references)	• Advanced DAW and video-editing tutorials Audacity Audacity Tutorials - YouTube Ableton Live Ableton Live For Beginners - YouTube Kdenlive LEARN KDENLIVE IN 15 MINUTES ~ Basic Video Editing Tuto... DaVinci Resolve DaVinci Resolve Beginners Tutorial 2025: Edit like a PRO for ... • Guidelines for QR code creation How to Create a QR Code in 5 Easy Steps • Checklist for exhibition setup

5 ANNEXES

5.1 Lesson Plan 1 Sound as Art and Science: From Physics to Creative Expression

FEEL	Sound is everywhere - from the natural environment to human-made spaces. It shapes our emotions, influences behavior, and serves as both a scientific phenomenon and a medium for artistic expression. Helping students to feel the presence of sound allows them to connect with its dual nature: physical and cultural. **Suggested teacher actions**: ● Play excerpts of John Cage (*4'33"*) or Bill Fontana's sound installations. Ask students: *What makes this sound art?* ● Discuss everyday sounds (traffic, wind, voices) and how they can be perceived aesthetically. ● Prompt questions such as: - How does sound affect the way we perceive our environment? - In what ways can sound be considered both science and art? - Can listening carefully help us better understand sustainability and cultural heritage? **Activity**: Students create a quick "sound mind map" on paper or digital boards (Padlet/Jamboard), linking emotions, physical properties, and artistic impressions.
IMAGINE	Now that students recognize sound's presence, they move into the scientific and creative imagination phase. They explore how vibrations, frequencies, and amplitudes are the building blocks of sound, and how artists transform them into expressive forms. **Suggested teacher actions**: • Short demo with classroom objects (a rubber band, a tuning fork, a bottle) to visualize vibration. • Use Chrome Music Lab (Oscillators, Spectrogram) to visualize sound properties.

	- Show examples of data transformed into sound (temperature - pitch, cycles - rhythm). **Activity**: Students imagine new possibilities for sound: - If *temperature had a melody*, what would it sound like? - If *a tree growing* could be heard, how would it change over time? - Small groups brainstorm datasets (environmental, personal, cultural) to transform into sound later.
CREATE	Students actively transform data into sound, applying their understanding of physics and creative imagination. **Suggested teacher actions**: - Guide groups in choosing a dataset (e.g., daily temperatures, lunar cycles, school attendance, personal steps). - Use Beepbox to map values (pitch = temperature, duration = day, etc.). - Record or edit sequences with Audacity or Ableton Live for refinement. **Activity**: - Each group designs **one short sonic piece** based on their dataset. - Encourage them to combine scientific accuracy (data mapping) with artistic creativity (choice of sounds, layering). - Students prepare short notes on their mapping rules to explain later.
SHARE	Sharing emphasizes reflection, communication, and community learning. Students present their sound creations and explain how data was transformed into sonic experiences. **Suggested teacher actions**:

	• Organize a listening session where each group presents their piece. • Provide peer-review structure: each group writes down one positive feedback and one question for another group. • Encourage students to reflect on how scientific data became artistic soundscapes. **Activity**: • Groups draft a **concept outline** for their final *Augmented Soundscape* project, linking today's practice to the larger module. • Conclude with a short class reflection: *What did we learn about sound as both physics and art?*

5.2 Lesson Plan 2 AI and Immersive Worlds: Designing the Augmented Soundscape

FEEL	**Context & Engagement** Artificial Intelligence (AI) and immersive technologies (AR/VR) are transforming how we experience and create art. From music composed with AI to exhibitions enhanced by augmented reality, these tools raise both exciting opportunities and critical questions about creativity, authorship, and ethics. **Teaching Resources** • **Discussion prompts:** - Can AI be considered a "creative partner"? - What are the differences between human and AI creativity? - What ethical issues (bias, authorship, originality) should we consider? - How could AR/VR reshape the way we share and experience culture? **Suggested Activity**

	● In small groups, students watch short examples of AI art and AR/VR immersive installations. ● They **reflect on their emotional responses** and **map key ideas** on a mind map or Jamboard. ● Teachers encourage them to identify both **possibilities** (new artistic expressions, accessibility, interaction) and **challenges** (bias, environmental costs, authorship). **Annex Material**: ● Worksheet: *"AI & AR/VR Reflections"* - space for noting positive/negative aspects, open questions, and personal reactions.
IMAGINE	**Exploration of Tools & Concepts** Students begin experimenting with AI tools to **visualize their dataset themes** (e.g., environmental data, cultural heritage, personal stories). **Step-by-step Guidance** 1. **Image generation:** Use free/accessible AI platforms (DALL.E, Craiyon, Copilot, Leonardo) to create visuals. - Example prompt: *"Generate an image inspired by the daily temperature variations in our town"*. 2. **Discussion:** Students compare results, discussing: - Do the outputs reflect the dataset? - What is missing or misleading? - What biases can they notice? 3. **Ethics reflection:** Introduce a quick checklist on authorship, originality, and responsible use of AI. **Annex Material**:

<table>
<tr><td>CREATE</td><td>
Integration of AI + Soundscape + Immersion
Now students expand their soundscape with AI-generated visual and audio content.

Step-by-step Activities

1. Melobytes activity: Convert one AI-generated image into a sound texture.

2. Audio integration: Combine this new sound with their existing sequences (from Lesson 1) using Audacity or Ableton Live.

3. Immersive design:

- Sketch how users will interact with the augmented soundscape (e.g., scanning a QR code, pointing a phone at a marker, entering a VR space).

- Build a flowchart of user experience: trigger - soundscape - visual response.

Group Work Output:

● 1 short audiovisual experiment (AI + sound).

● 1 draft flowchart of immersive design.

Annex Material:

● Worksheet: “Designing our Immersive Soundscape” - structured with sections for:

- Visual Assets

- Audio Assets

- User Interaction Flow

- Technical Requirements
</td></tr>
<tr><td>SHARE</td><td>Presentation & Feedback</td></tr>
</table>

	• Each group **presents its immersive concept**: - What visuals and sounds they generated. - How the user will interact with the work. - Which challenges they faced (technical, ethical, artistic). • Peers leave **feedback notes** (positive comment + constructive suggestion). **Wrap-up Reflection** • Collective discussion on how AI and immersive media could **enrich or threaten cultural practices**. • Teacher guides students to connect with **SDGs**: responsible innovation, sustainable tech, inclusive cultural heritage. **Annex Material**: • *Peer Feedback Sheet* (with 2 prompts: "I liked…" / "I suggest…"). • *Reflection Sheet*: "How can AI/AR/VR help us tell stories about our world responsibly?"

5.3 Lesson Plan 3 Bringing life: the Augmented Soundscape

FEEL	**Context & Engagement** Students have now created sounds, visuals, and immersive ideas. The final challenge is to **integrate all elements into a coherent augmented soundscape** and prepare it for sharing with peers, school, and community. This phase emphasizes the importance of storytelling, presentation, and the **social impact of creative projects**. **Teaching Resources** Examples of AR markers (Artivive, Zappar demos). Zappar Showcase: The best XR Examples **Discussion Prompts**

	● What makes a presentation engaging for an audience? ● How can we make sure our augmented soundscape is **understandable, accessible, and respectful**? ● Why is it important to share art with the community? **Annex Material**: **Worksheet: Preparing to Share - Presentation Checklist** Use this checklist to make sure your presentation is clear, reliable, and inclusive. **1. Clarity** ☐ My main message is clear and easy to understand. ☐ I have an introduction, main points, and a conclusion. ☐ I use simple, direct language (avoid jargon unless explained). ☐ Visuals (slides, images, charts) support my message, not distract from it. ☐ I've practiced explaining complex ideas in plain words. **2. Technical Reliability** ☐ My slides, audio, or video open correctly on the presentation device. ☐ Fonts and images are readable (large enough, high contrast). ☐ I checked sound levels (if using music or voice recordings). ☐ I have a backup (USB copy, cloud link, printed notes). ☐ I tested timing to make sure I stay within the limit. **3. Inclusivity** ☐ My presentation can be understood by people with different backgrounds. ☐ I avoid stereotypes or biased language. ☐ Images and examples reflect diversity. ☐ I describe visuals briefly for anyone who might not see them clearly. ☐ I use clear text and high-contrast colors for accessibility. **Final Check** ☐ I feel confident explaining my topic.

	☐ I'm prepared for possible questions. ☐ I've practiced at least once in front of someone else (or recorded myself). Tip: "Before presenting, ask yourself: If I were in the audience, would I understand, follow, and feel included?"
IMAGINE	**Exploration & Planning** Students brainstorm different ways to **bring their soundscape to life** in a final experience. **Step-by-step Guidance** 1. **Design Thinking warm-up:** groups revisit their soundscape + visuals and ask: - What story do we want to tell? - Who is our audience? - How will they interact with our work? 2. **Formats to consider:** - QR codes linking to soundscape maps. - Posters with AR triggers. - Small school exhibition with interactive corners. - Online sharing (class website, podcast). **Annex Material**: **Worksheet: Our Exhibition Plan** Use this worksheet to organize and prepare your exhibition.

Target Audience
Who do we want to reach with our exhibition?

Format Choice
What kind of format (installation, performance, digital, mixed)?

Roles
Who is responsible for what? (curator, designer, communicator, etc.)

Materials Needed
What do we need to prepare (equipment, artworks, props, tech)?

- Quick guide: “How to generate QR codes for free”.

[How to Create a QR Code in 5 Easy Steps](#)
[QRCode Monkey](#)
[QR code - Canva Apps](#)

CREATE	**Production & Integration** Groups now assemble their augmented soundscape and prepare the final presentation. **Step-by-step Activities** 1. **Editing & Finalization**: - Mix sounds and visuals into a coherent sequence (Audacity, Ableton, or video editors). - Test AR triggers or QR codes with classmates. 2. **Exhibition Design**: - Decide on placement of posters, markers, or screens. - Write a short explanatory text (title, authors, description). 3. **Rehearsal**: groups practice explaining their project in 2–3 minutes. **Group Work Output** ● 1 final audiovisual + immersive prototype. ● 1 plan for how it will be shared in school/community. **Annex Material**: ● Worksheet: *“Exhibition Setup Plan”* - including: space design, technical setup, explanatory text. ● Template: *“Artwork Label”* (title, group name, short description, QR code).
SHARE	**Presentation & Community Sharing** ● **Final Vernissage / Showcase:** - **Each group presents its augmented soundscape.** - **Audience (classmates, teachers, possibly parents or local partners) interact with QR/AR experiences.** ● **Peer and teacher feedback: constructive, focusing on clarity, creativity, and impact.** ● **Collective reflection: how has the project changed our way of listening to and representing the environment?** **Annex Material:** ● **Peer Feedback Sheet (criteria: creativity, clarity, interaction, collaboration).** ● **Reflection Sheet: “What did I learn from sharing my work?”** ● **Certificate Template (optional, to acknowledge student participation in the project).**

Module 3

Learning STEAM Trough Making and Tinkering

Co-funded by the European Union

Funded by the European Union through the CREATIVE EUROPE Programme. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or European Education and Culture Executive Agency (EACEA). Neither the European Union nor the granting authority can be held responsible for them.

Project n°: 101173445 — CREA-CULT-2024-COOP

Our project partners:

Author(s): Priscila Doran, David Sousa, Geuffer Garcia

Institution(s): NUCLIO

Date: July & August 2025

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Commission. Neither the European Union nor the granting authority can be held responsible for them.

Table of Contents

1 Introduction

1.1 Purpose of the document

This document brings together a series of modular lesson plans designed under the STEAM Innovation project, which offers teachers ready-to-use units that can be combined or taught separately to build students' maker skills. Each module follows the four stages of design thinking (feel, imagine, create, share). We aim to guide teachers and students step by step to learn with hands-on challenges in 3D modelling and printing, basic electronics, and block-based programming with micro:bit so that students have the competencies to create an innovative product by themselves.

The lesson plans will be presented as "puzzle pieces." Teachers can choose the activities that best suit their classroom curriculum goals and advance toward the shared objective "to empower young creators to develop truly innovative products".

Students can imagine, design and create a product that may be a functional 3D model for 3D printing, assemble battery-powered motors and circuits, write simple code to drive LEDs, sensors and/or motors or maybe connect each one of this area in one awesome creation. We hope that each lesson plan can cultivate creativity, resourcefulness, collaboration, and problem-solving.

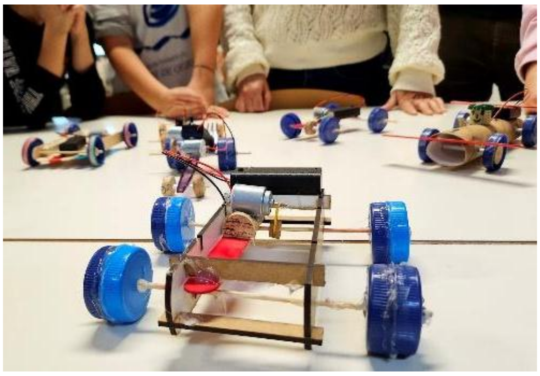
These lesson plans combined will build a pathway to enhance competencies for more advanced and real-world applications, for example, a prototype of a robot part, a custom smartphone stand, or maybe embed electronics into 3D-printed enclosures. Learners will be encouraged to identify local needs, think and prototype solutions, test it, modify their designs (if needed) to that they could fulfill its purpose. We recommended that the students share their outcomes with their parents, teachers, school and local community.

The final aim of this collection is to enhance students' competencies to make them feel like genuine change makers, that is confident in their ability to harness STEAM tools and methodologies, that are agile in their thinking, and motivated to address challenges in school, at home, or within their wider community.

2 Module Description

2.1 Introduction

The Maker movement has been revolutionizing the world of STEAM education by raising awareness for the power of learning by doing and of creativity to solve real-life problems. While maker spaces are often associated with the use of expensive and state-of-the-art technologies, such as 3D printers, laser cutting, and engraving machines, maker education focuses on **learning how to create innovative solutions using what is at one's disposal**. This means that anyone can be a maker as long as they put into practice competences, such as **resilience, resourcefulness, creativity, innovation and collaboration.** Students who engage with maker education develop important competencies for life while deeply learning curriculum content associated with real-life situations. Furthermore, they understand that they can be active citizens and contribute to the improvement of their communities if they only find the opportunity and inspiration to do so.



Change Makers activities encourage teachers and students to learn basic and advanced creative digital skills and apply them in real-world contexts. More importantly, it encourages them to become change agents in their communities, designing innovative solutions to local problems, using whatever resources are available.

Professional development opportunities will be offered to teachers to build capacity in maker education and prepare them with important STEAM digital skills (such as 3d modelling and printing, vector design, electronics, programming, among others). Training courses will privilege pedagogical models that follow a student-centred approach, such as Design Thinking and assessment strategies to assess students' competence development in an equitable approach. Workshops

Workshops for students will be organized to promote the same STEAM digital skills and other important competencies such as collaboration, resilience, creativity, resourcefulness, etc, in students and encourage students to develop creative solutions for existing local problems.

2.2 Learning objectives

The main goal of Change Makers activities in STEAM Innovation will be to support students through an entrepreneurial journey to develop an innovative solution to an existing local problem. To support this, the will be to develop maker competences while learning curriculum content (when integrated in formal education) or exploring other learning outcomes related to real-life contexts (when integrated in non-formal education). While the main goal is the development of competences, the learning content will vary according to the project theme that students and teachers select.

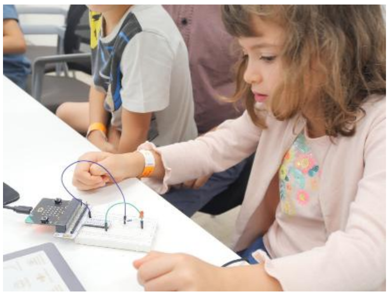
In this sense, in addition to deeply learning content related to their projects' theme, students who engage with Change Makers activities will develop competences related to:

- Digital fabrication: 3d modelling and printing/laser cutting and engraving
- Vector design and digital creativity
- Electronics and electric circuits
- Programming and sensor
- Artificial Intelligence

While learning these specific digital skills, students also develop:

- Creativity: Students must use creativity to invent new solutions for local problems
- Resilience: Students must develop the ability to continue trying despite difficulties and failures
- Resourcefulness: Students will have to design solutions using whatever resources they have at their disposal.
- Innovation: Students will have to be innovative to be able to solve problems that have not been solved before.
- Collaboration: Students will work in groups; therefore, they will develop collaborative abilities.
- Communication: To properly work in groups, students will have to learn how to listen and speak with respect and clearly and effectively.
- Active citizenship: Students will understand that, whatever their age, they can be active citizens and promote improvement in their community.

In the context of STEAM Innovation, students will be invited to not only develop a creative solution for an existing local problem but to become agile communicators and "sell" their ideas to others. Through this, they will also develop **self-confidence** and **entrepreneurial competencies**.



2.3 Available partnership opportunities

1.3 Available partnership opportunities

Here are some partnership opportunities you should consider in your development:

Stakeholder	Partnership description/Contribution
Parents	Verify if students' parents present any skills that can complement the work they are doing. Maybe some work in STEAM professions. Others might be handicraft enthusiasts or 3d printing lovers. Even if none of these are applicable, diversity of perspectives is always enriching, and parents can help with new ideas and contribute in whatever way they want.
Local businesses	Schools should search for nearby maker spaces and FabLabs that might be willing to collaborate. Local businesses can benefit from students' creations. Students can perform an initial participatory study with the local business community to see whether they have any issues that need to be solved. They can also contribute to students' work with resources, funding, skills and ideas.

Local authorities	Local authorities can support students' work by offering insights into local issues and existing solutions. Students should also share their solutions with local authorities and share recommendations for community development.
NGOs	Local NGO's can also support students' work in defining local issues that need to be solved and co-creating solutions.
Artists	Inviting artists to co-create the solutions for the identified issues can be a way to enhance the artistic quality and foster artistic competencies in students. If a resident artist exists, they can be invited to be part of the students' work. They can also be engaged as consultants.
Researchers and research institutes	Research institutes might already be working on creating solutions for existing local problems. They can be invited to offer insights to students and to spark their interest in the science behind the issues selected. They might also have resources and mentors available for students.
Local community	Search the local community for daycare centres, youth associations and other community stakeholders that might want to be part of students' projects, either as contributors with ideas or as co-creators of the solutions.

2.4 Recommended resources

Students can work with any resources they have at their disposal. If the school has 3d printers and/or laser cutting and engraving machines, they should be made available for the students. Likewise, electronics and programming kits, if existing, should be offered for use during the project.

However, students can design innovative ideas and solutions for existing problems using reusable materials such as cardboard, inks, glue, tape, scissors, and whatever handicraft material they can access.

2.5 Age of students involved

9 – 18

2.6 Subject domain

All

3 Implementing the Module following the Design Thinking Approach

<table>
<tr>
<td>FEEL
What is the problem demanding action from the schools</td>
<td>Phase I – Question
This is the moment when the project begins. In this phase, students will choose or be introduced to the theme that will be explored throughout the project. The goal is for them to engage in deep and comprehensive learning about the topic, how it relates to their daily lives and what elements of their community it affects.

Teachers should think of a way to motivate and engage students when introducing the theme, to captivate them from the start and keep them involved throughout the project.

This is also the phase in which students should pose their own questions, create hypotheses (supported by valid arguments), and find opportunities to research and experiment in order to reach their own conclusions about the problem at hand.

The aim is for students to fully understand the problem so that in the next phase, they can unleash their imagination and think of possible solutions.

On the “feel” phase it is important that teachers inspire students to think about real-life challenges that need attention in their school or local community. Students must explore and ask powerful questions to discover local necessities and maybe systemic issues.

Students might explore:
● What problems affect our school or neighbourhood most?
● Are there everyday challenges that people have just "gotten used to"?
● Who is impacted most by these problems? How?
● What would be our ideal community, or what could our school look like?
● How can we make our school more sustainable or inclusive?

The identification of real-life challenges within their schools or local community can encourage students to build empathy. They can look beyond their immediate experience and consider the perspectives of others in their community. Furthermore, this phase can present an important opportunity to raise the voice of students and allow them to be involved in the school’s daily life in a democratic way.

Phase II – Evidence
Once questions are formed, students can begin to gather data and evidence to better understand the problem. For that, students can do (1) Interviews with peers, teachers, family members, and local stakeholders; (2) Surveys or polls to gather broader input; (3) Observation (e.g., spending time noticing behaviours, workflows, pain points); (4) Research into existing data, policies, or scientific studies. (5) Register important dates.</td>
</tr>
</table>

	Teachers can teach students how to record and interpret their findings critically, identifying patterns, contradictions, or unexpected insights. This stage lays the foundation for truly needs-based innovation and encourages students to think like community researchers. To a fluid work, students can use field notebooks, Audio/video recordings of interviews, empathy maps and stakeholder maps, Google Forms for digital surveys, community walk-throughs (with a checklist of observations). This phase helps shift students from "we think the problem is…" to "we know the problem is… because we've seen and heard the evidence."
IMAGINE *How could the school's students act up?* *What partnerships are required?*	**Phase III – Analyse** At this point, students should already be "experts" in the topic they are working on. They already understand the problem and how it relates to their daily lives and the different elements of their community. This phase is the phase of letting their imagination run wild and exploring all the ideas that may arise between students and teachers about what to do to solve the problem. It is also the moment to think about what the goals are: To bring awareness to a topic? To solve a practical problem? To create something new? Once the goals are well established, an open "brainstorming" session should be organized where students think about how to achieve the goal. With the objective to narrow down the problem, students can work collaboratively to create a clear and actionable challenge statement. For example: "How might we help students who feel excluded during recess to feel more included and engaged?" This is the starting point for idea generation. In this phase, students can use Problem Trees / Root Cause Diagrams and/or SWOT Analysis (Strengths, Weaknesses, Opportunities and Threats). They can brainstorm around "How Might We…" questions and do a Stakeholder Mapping Suggestion: Do an imagination icebreaker to kick-start students' ideas: Students can write down as many ideas as they can in a short period of time. Ex: 5 minutes. Then the ideas can be organised into categories (e.g. easy/hard ideas, short/long-term ideas, fun ideas, out-of-the-box ideas, etc.). In a third phase, students should choose one or more concrete ideas on which they will work in the next phase. If there are community stakeholders involved in the project, they should be invited to participate in the brainstorming session. Sometimes the best ideas come from the most unexpected places.

	Students might identify the root causes of the problem. They can map out needs and constraints (e.g., time, resources, knowledge), identify patterns and leverage points where action would be most effective and discuss how STEAM knowledge and makers' way of thinking might address the issue. **Phase IV – Explain** Students will begin to generate creative ideas after the definition of the challenges. They might identify who they need as partners to turn those ideas into reality, and it is important to always remember who will be the target audience for the product you will create in the project. Students must think of ideas that suit this audience so that the project has the real intended impact. The needs of this audience should be considered, and how they can be addressed with the project. If the final target is not an audience, but some other element of the community (plants, animals, a lake, a street, etc.), the process remains the same. Always consider as the main factor, the real needs you are addressing. The students can brainstorm multiple possible solutions, even unconventional or wild ideas. They can also explore what skills or resources they might need to implement them. In this phase, they can draft a preliminary project plan or prototype concept and identify potential partners (parents, NGOs, Makerspaces, artists, businesses, etc.) The goal is to articulate a vision for change, not just what the solution might be, but how it could work in real life, with real partners, in real communities. Here is an example output: "We imagine developing a low-cost air quality monitoring station using Arduino sensors, which can be installed around our school and neighbourhood. This station will display real-time pollution data on a digital screen. We will partner with a local Makerspace to 3D-print the casing, collaborate with a science teacher to calibrate the sensors, and invite a local NGO focused on environmental education to help us raise awareness through school campaigns.
CREATE *Describe the activities*	**Phase V – Connect** Students will create something to carry out the ideas they selected in the previous phase. They will be able to create anything, so that in the final phase of the project, they can share it. It is important to think concretely about what they will create, how much time it will take, what materials they will need, what support they will need, etc. Give students the opportunity to do some organized planning of the process before they begin. Anticipate what they will need to be successful and what steps they will take. If possible, allow the error to happen. It is through mistakes that students find the opportunity to correct themselves and learn more deeply.

	It is natural that at this stage, they will encounter several moments of trial and error until they manage to create the planned product. It is also possible that when putting ideas into practice, students recognize that some ideas may need to be revised, so it is important to keep a record of all the ideas that emerged in the previous phase. Students can design and build their solutions using Maker methodologies. They can organize into collaborative teams and begin to work on their prototypes, using available tools and materials. The activities involve: ● Plan the project workflow (materials, tools, timelines, roles) ● Use Maker technologies (when available) like: o 3D modelling and printing to design enclosures or custom parts o Vector design software for signage, interfaces, or decorative elements o Laser cutting to create precise components from wood or acrylic o Arduino or micro:bit platforms to develop smart, interactive features o Electronics kits to integrate sensors, lights, or motors ● Combine digital fabrication with recycled or low-cost materials (e.g., cardboard, plastics, scrap wood, etc) Here is an example output: “Students can build a smart plant watering system using Arduino/Micro:bit moisture sensors, 3D-printed parts, and a laser-cut display panel showing soil humidity. They connect with the school janitor and local gardening club to test it in real garden beds.” This phase focuses on experiential learning, where failure and iteration are part of the process. Students learn to adapt, debug, and optimize their prototypes while applying real-world STEAM concepts. An outcome can be a functional prototype that addresses the challenge identified, created using Maker tools and collaborative problem-solving. In cases where students don’t have all the necessary materials available, they can design a mock-up representing their idea, using recycled materials and use storytelling to explain the idea behind it.
SHARE *How do you plan to share the outcomes of your activities and build new partnerships?*	**Phase VI – Communication** This is the final phase of the project, and the most rewarding moment of all. It is time to share the work!! At this point, the product will already be created, and the only thing left to do is plan how it will be shared. This stage will vary depending on the project objectives; however, the common aspect is the planning and dissemination that must be done beforehand. At this point, students should prepare to share their results with the class/school/families/community, etc., in order to achieve the greatest possible impact.

	They can showcase their Maker-based solutions in various formats and platforms. This method can amplify their voice and build visibility for their work. The goal is to communicate the impact of their projects and engage stakeholders who can support further development. Activities include: ● Organizing a local exhibition or "Maker Fair" at school or a community centre and inviting parents, local businesses, authorities, and NGOs. ● Showing the prototypes in public events (e.g., municipal sustainability week, tech expos). ● Creating videos or portfolios where they can explain the challenges, design process, and final product. ● Sharing the outcomes on social media, school websites and newsletters to reach a broader audience. ● Engaging partners by inviting them to evaluate or contribute to future iterations of the solution. When sharing, students should remember to record the moment with photos and videos as a keepsake. Example: Students designed an automated bird feeder using 3D-printed parts and programmed a sensor-triggered food dispenser. They created a project video tutorial and published it on the school's YouTube channel and website. They also hosted a "Tech for Nature" open day where local environmental NGOs and parents were invited to test the prototype and discuss possible improvements for local biodiversity support. **Phase VII – Reflection** Reflection helps consolidate the learning experience and evaluate both the process and the impact of the activity. This stage reinforces metacognitive skills and identifies future opportunities. Activities can include: ● Guided group discussions on: o What went well? o What was challenging? o What would we do differently next time? ● Creating a reflection journal or video diary to document individual and team learning. ● Feedback sessions with teachers, peers, and community partners. ● Mapping out next steps (e.g., how to continue improving the prototype or scale the solution). Example: Students reflect on how learning to solder and code helped them bring their air quality station to life, and how working with local environmental groups gave them real-world purpose. Students discuss on the success of their project and how they can improve the discovered limitations. It is also important to celebrate the success and ensure students feel proud in the end.

4 Description of the Lesson Plans in the Module

4.1 Introduction

Here are the Lesson Plans in this Module:

- Lesson Plan 1 - Electronics I
- Lesson Plan 2 - Electronics and Programming I
- Lesson Plan 3 - 3D Modeling and Printing I
- Lesson Plan 4 - Electronics and Programming II
- Lesson Plan 5 - 3D Modeling and Printing II
- Lesson Plan 6 - Video and sound editing and use of the web studio
- Lesson Plan 7 - Vector graphics Design

4.2 Lesson Plan 1

<table>
<tr><td>Title</td><td colspan="3">Electronics I</td></tr>
<tr><td>Duration</td><td colspan="3">1h30 - 2 hours</td></tr>
<tr><td>Specific Learning Objectives</td><td colspan="3">Comprehend basic electric circuits (series, parallel, switches, resistors).
Apply knowledge to build creative electronic projects.
Develop skills in planning, creating, and sharing STEAM-based work.</td></tr>
<tr><td>Key STEAM Elements</td><td colspan="3"><u>Science:</u> Learn basic electric circuits, current flow, and Ohm's Law.
<u>Technology:</u> Use of online simulators and electronic components
<u>Engineering:</u> Build functional projects.
<u>Arts:</u> Design and decorate the projects
<u>Mathematics:</u> Apply Ohm's Law, analyse voltage and current in circuits</td></tr>
<tr><td>SDG/ Sustainability / Cultural Heritage Focus</td><td colspan="3"><u>SDG 4 – Quality Education:</u> Promotes digital skills and innovation
<u>SDG 9 – Industry, Innovation, and Infrastructure:</u> Encourages creative use of tech for real-world solutions; Sustainability via reuse of components and low-power microcontrollers</td></tr>
<tr><td>Materials / Resources Needed</td><td colspan="3">Batteries, wires, resistors, LEDs, DC motors, switches and conductive tape
Recycled materials (cups, cardboard, and other materials)
Computers with internet access</td></tr>
<tr><td rowspan="2">Description of Specific Activities</td><td>Step</td><td>Description of the activities</td><td>Duration</td></tr>
<tr><td>Feel:</td><td>Introduce the role of electronics in daily life. Use videos and group discussions to explore its impact across disciplines.</td><td>30 - 45 min</td></tr>
</table>

	Imagine:	Students use online tools to experiment with simple circuits and plan creative projects.	30 - 45 min
	Create:	Create a painting robot, an electronic postcard, an electric car, or a similar product using circuits and recycled materials.	60 min
	Share:	Students present their projects, give and receive peer feedback, and reflect together on creativity, technical aspects, and lessons learned.	30 min
Follow up activities (if needed)	Improve the project by integrating other electronic components. For example, add LEDs to the curcuit of the car or robot, or make a 3D version of the electronic postcard.		
Assessment / Reflection / Feedback	● ASSESS assessment rubrics of collaboration, creativity and communication or other competences teachers find more suit to their context. ● Circuit design checklists ● Functionality of the the product ● Student presentations and reflections		
List of Educational Material (presentations, videos, reading material, exercises/worksheets, references)	● Video for reflection about the impact of technology in the world ● Online PHET circuit construction kit ● Examples of electric circuits for creative school activites ● How to build a painting robot (Video) ● How to build a painting robot (Text) ● How to build an electronic postcard (Video) ● How to build an electric car (Video)		

4.3 Lesson Plan 2

Title	Electronics and Programming I
Duration	1h30 - 2 hours
Specific Learning Objectives	● Understand basic principles of electronics and programming ● Learn to use the micro:bit microcontroller and its sensors ● Apply code to control hardware components (LEDs, sensors) ● Adapt and extend simple circuits creatively ● Develop teamwork, critical thinking, and problem-solving skills

<table>
<tr><td>Key STEAM Elements</td><td colspan="3"><u>Science:</u> Electrical components, sensors, circuits
<u>Technology:</u> Programming microcontrollers, using online editors
<u>Engineering:</u> Designing and modifying functional systems
<u>Arts:</u> Designing aesthetically pleasing, interactive devices
<u>Mathematics:</u> Using logic and timing to control hardware behavior</td></tr>
<tr><td>SDG/ Sustainability / Cultural Heritage Focus</td><td colspan="3"><u>SDG 4 – Quality Education:</u> Promotes digital skills and innovation
<u>SDG 9 – Industry, Innovation, and Infrastructure:</u> Encourages creative use of tech for real-world solutions; Sustainability via reuse of components and low-power microcontrollers</td></tr>
<tr><td>Materials / Resources Needed</td><td colspan="3">micro:bit microcontrollers
Breadboards, LEDs, resistors, jumper wires
Laptops or tablets with internet access
Sticky notes, markers for peer feedback</td></tr>
<tr><td rowspan="5">Description of Specific Activities</td><td>Step</td><td>Description of the activities</td><td>Duration</td></tr>
<tr><td>Feel:</td><td>Introduce the impact of electronics and programming using videos and guided discussion. Students work in small groups to reflect and map out their ideas visually.</td><td>30 - 45 min</td></tr>
<tr><td>Imagine:</td><td>Students explore the micro:bit and its sensors through guided tutorials. They experiment freely and imagine what they could create using what they've learned.</td><td>30 - 45 min</td></tr>
<tr><td>Create:</td><td>Students build a basic traffic light system using micro:bit and LEDs, then adapt the same circuit to respond to sensors in new ways.</td><td>60 min</td></tr>
<tr><td>Share:</td><td>Students do a "Project Swap". The session ends with a class discussion on insights and discoveries.</td><td>30 min</td></tr>
<tr><td>Follow up activities (if needed)</td><td colspan="3">Improve the project by integrating other micro:bit functions or other electronic components, such as a LED strip. For example, have different micro:bits communicating via radio en triggering events on the other's circuit.</td></tr>
<tr><td>Assessment / Reflection / Feedback</td><td colspan="3"><u>ASSESS</u> assessment rubrics of collaboration, creativity and communication or other competences teachers find more suit to their context.
Code creation and circuit design checklists
Functionality of the product
Student presentations and reflections</td></tr>
</table>

List of Educational Material (presentations, videos, reading material, exercises/worksheets, references)	• Introduction video for reflection about Electronics & Programming • Official micro:bit Website • Makecode Programming Platform • mBlock Programming Platform • Scratch Programming Platform • Tinkercad Simulator Platform • Compass Bearing Tutorial • Beating Heart Tutorial • Sunlight Sensor Tutorial • Step Counter Tutorial • *Sound Meter Tutorial* • *Thermometer Tutorial* • *Breadboard Tutorial (Video)* • Beginner micro:bit Projects • Advanced micro:bit Projects

4.4 Lesson Plan 3

Title	3D Modeling and Printing I
Duration	3 hours
Specific Learning Objectives	• Understand the principles of 3D modeling and additive manufacturing • Use TinkerCAD to design a basic 3D object (keychain) • Prepare a 3D model for 3D printing using OrcaSlicer • Gain awareness of real-world applications of 3D printing • Develop creativity, spatial reasoning, and design thinking skills
Key STEAM Elements	• Science: digital fabrication and material properties • Technology: use of 3D software and slicers • Engineering: designing functional, printable objects • Arts: visual design, personalisation, and creativity • Mathematics: working with dimensions, proportions, and geometry
SDG/ Sustainability / Cultural Heritage Focus	• SDG 9 – Industry, Innovation, and Infrastructure • SDG 12 – Responsible Consumption and Production • Awareness of sustainable design and local innovation
Materials / Resources Needed	• Computers with internet access and a computer mouse • TinkerCAD accounts (free online) • OrcaSlicer software (Open-source free software) • 3D printer and PLA filament • Projector for video tutorials • Worksheets or sketch paper for planning • Example 3D printed models for inspiration

<table>
<tr><td></td><td colspan="3"></td></tr>
<tr><td rowspan="5">Description of Specific Activities</td><td>Step</td><td>Description of the activities</td><td>Duration</td></tr>
<tr><td>Feel:</td><td>The teacher introduces 3D modeling and printing for the students. The teacher explains the process to create digital designs and transform them into physical objects. Students watch videos that show real-world applications of 3D printing (e.g., in architecture, medicine, art, and construction). Students reflect on what kind of objects could be created or improved using 3D printing and discuss possible uses in their daily lives.</td><td>45 min</td></tr>
<tr><td>Imagine:</td><td>Students are encouraged to brainstorm ideas and sketch a personalized keychain. They consider size, shape, and text elements to include. The focus is to plan the keychain, how the object is, what it looks like, and what it means to the student.</td><td>30 min</td></tr>
<tr><td>Create:</td><td>Students use TinkerCAD to build their keychain model. The teacher supports them on the basic tools (shapes, resize, text, hole). Once models are completed, they are exported and opened in OrcaSlicer. The teacher shows how to configure slicer settings (infill, supports, material) and generate a G-code file to print on the 3D printer.</td><td>60 min</td></tr>
<tr><td>Share:</td><td>The teacher demonstrates how to load the filament, preheat the 3D printer, and start the print. Students observe the printing process. When prints are ready, they reflect on what they learned and how they might improve their design. They share their experience with classmates in an open discussion.</td><td>45 min</td></tr>
<tr><td>Follow up activities (if needed)</td><td colspan="3">Create a keychain for a friend or family member with a new message or design
Design a small object with a specific function (e.g., cable holder, badge)
Introduce basic electronics to combine with future 3D designs
Do the Lesson Plan 5 - 3D Modeling and Printing II</td></tr>
<tr><td>Assessment / Reflection / Feedback</td><td colspan="3">ASSESS assessment rubrics of collaboration, creativity and communication or other competences teachers find more suit to their context.
Observation of students’ engagement during modeling
Review of completed digital model and printed object</td></tr>
</table>

List of Educational Material (presentations, videos, reading material, exercises/worksheets, references)	• What Is 3D Printing? • TinkerCAD Portal • The Race to 3D-Print Our World • How Concrete Homes are Built with a 3D Printer • 3D-Printing Heart Tissue With Human Stem Cells • World's Largest 3D Printed Boat • The World's Very First 3D-Printed Bridge is Open in Amsterdam • 11 USEFUL Things to 3D Print First • TinkerCAD - Tutorial for Beginners • Orca Slicer getting started guide • The 5 Filament Types You Need to Know • **Please read the complete Lesson Plan here**

4.5 Lesson Plan 4

Title	Electronics and Programming II
Duration	1h30 - 2 hours
Specific Learning Objectives	• Understand how to use the micro:bit microcontroller sensors to collect environmental data • Learn how to log and export temperature readings • Explore the concept of sonification as a method of data representation • Promote inclusion through alternative data communication methods • Foster creativity, collaboration, and critical thinking
Key STEAM Elements	• Science: Measuring environmental variables (temperature) • Technology: Using micro:bit, sensors, programming, and data logging • Engineering: Designing and coding systems that capture and sonify data • Arts: Creating sound compositions from scientific data • Mathematics: Mapping temperature ranges to sound frequencies or scales
SDG/ Sustainability / Cultural Heritage Focus	• SDG 4 – Quality Education: Inclusive digital literacy through auditory learning

<table>
<tr><td></td><td>
SDG 10 – Reduced Inequalities: Promoting accessibility and inclusion; use of sound as a universal language for communication and understanding
</td></tr>
<tr><td>Materials / Resources Needed</td><td>
micro:bit microcontroller
Computers with internet access
Headphones or speakers for playback Sticky notes or forms for reflection
</td></tr>
<tr><td>Description of Specific Activities</td><td>
<table>
<tr><th>Step</th><th>Description of the activities</th><th>Duration</th></tr>
<tr><td>Feel:</td><td>Introduce the role of electronics in daily life. Use videos and group discussions to explore its impact across disciplines.</td><td>30 - 45 min</td></tr>
<tr><td>Imagine:</td><td>Students explore micro:bit tutorials, and learn the basics of Makecode and the concept of sonification. They are encouraged to think about how sounds can reflect environmental data and how that can be creatively interpreted.</td><td>30 - 45 min</td></tr>
<tr><td>Create:</td><td>Students build a data logging system with the micro:bit, export the collected data and use and sonify it in real-time or after data collection. They are encouraged to explore musical parameters and think creatively about the final output.</td><td>60 min</td></tr>
<tr><td>Share:</td><td>“Data Jam” session, followed by a class discussion, reflecting on how sound can represent information and how sonification can enhance understanding and accessibility.</td><td>30 min</td></tr>
</table>
</td></tr>
<tr><td>Follow up activities (if needed)</td><td>
Adapt the activity to a long-term data collection experiment.
Play the data using real instruments.
</td></tr>
<tr><td>Assessment / Reflection / Feedback</td><td>
ASSESS assessment rubrics of collaboration, creativity and communication or other competences teachers find more suit to their context.
Code creation and sonification design checklists
Functionality of the sonification product
Student presentations and reflections
</td></tr>
<tr><td>List of Educational Material (presentations, videos, reading material, exercises/worksheets, references)</td><td>
Introduction video for reflection about Electronics & Programming
Official micro:bit Website
Makecode Programming Platform
mBlock Programming Platform
Scratch Programming Platform
Tinkercad Simulator Platform
Compass Bearing Tutorial
</td></tr>
</table>

	● Beating Heart Tutorial ● Sunlight Sensor Tutorial ● Step Counter Tutorial ● *Sound Meter Tutorial* ● *Thermometer Tutorial* ● SoundScapes resources ● TwoTone sonification tool ● Sonification tutorial video

4.6 Lesson Plan 5

Title	3D Modeling and Printing II		
Duration	3 to 5 hours (depending on printing time and project complexity)		
Specific Learning Objectives	● Develop advanced 3D modeling skills using TinkerCAD ● Apply design thinking to develop innovative, functional products ● Integrate 3D printing with basic electronics and programming ● Explore iteration, problem-solving, and creativity through making ● Understand how STEAM tools can address real-world challenges		
Key STEAM Elements	● Science: physical principles, circuits, and applied design ● Technology: digital modeling, slicing, and 3D printing ● Engineering: prototype a functional object design ● Arts: creative solutions, form, and personalisation ● Mathematics: measurement, geometry, tolerances		
SDG/ Sustainability / Cultural Heritage Focus	● SDG 4 – Quality Education ● SDG 9 – Industry, Innovation and Infrastructure ● SDG 12 – Responsible Consumption and Production ● Encouraging sustainable innovation and community-oriented design		
Materials / Resources Needed	● Computers with internet and TinkerCAD access ● OrcaSlicer installed on each the computer ● 3D printers and PLA filament ● Batteries, DC motors, Micro:bit boards (optional integration) ● Sketching materials (paper, pencils) ● Videos and tutorials for advanced modeling techniques ● Examples of 3D-printed innovations (physical or video)		
Description of Specific Activities	**Step**	**Description of the activities**	**Duration**
	Feel:	Students reflect on real-world problems and explore how 3D printing can be used to create functional and innovative solutions. They watch inspiring videos and browse	45 - 60 min

		platforms like Thingiverse for ideas. Teacher introduces the connection with electronics and micro:bit for possible integration.	
	Imagine:	Students brainstorm and sketch ideas for functional 3D-printed products. They explore applications such as a robot chassis, mobile stand, organizer, toy, or micro:bit accessory. Teachers help them define purpose, size, functionality, and materials.	30 - 45 min
	Create:	Students build their designs in TinkerCAD, using advanced modeling tools (e.g. alignment, articulation, hollows). With teacher guidance, they export the STL, prepare the G-code in OrcaSlicer, and print their models. Some may begin testing electronics or programming integration.	60 - 120 min
	Share:	Students present their projects to the class. Each one of them explains their design process, functionality and challenges. Reflections are encouraged with questions like: What worked? What didn't? What would you improve? What did you learn about innovation?	30 - 45 min
Follow up activities (if needed)	● Improve or reprint designs based on test results ● Integrate micro:bit code or circuits into the printed product ● Present inventions to other classes or parents ● Submit design ideas for community challenges		
Assessment / Reflection / Feedback	● ASSESS assessment rubrics of collaboration, creativity and communication or other competences teachers find more suit to their context. ● Observation of modeling and printing process ● Functionality of the printed object ● Student presentations and reflections		
List of Educational Material (presentations, videos, reading material, exercises/worksheets, references)	● 12 BRILLIANT & INNOVATIVE 3D Prints That Make Life Easier ● Cool 3D Prints That Use GRAVITY & PHYSICS ● Unique Functional 3D Prints I Use Every Day ● 5 Practical Camping 3D Prints That Actually Work ● 5 Must-Know 3D Printing Tips & Tricks ● Complex Shapes in Tinkercad ● Make a 3D Print Out of Any Outline Image in Tinkercad ● How to make: Mini Box Using Tinkercad ● How to Make a Bolt and Nut in Tinkercad That Really Work ● Creating Articulated Models in Tinkercad ● Simple ways to create your own 3D models ● TinkerCAD Portal ● Thingiverse Portal		

	• **Please read the complete Lesson Plan here**

4.7 Lesson Plan 6

Title	Video and sound editing and use of the web studio
Duration	4 to 6 hours
Specific Learning Objectives	• Understand the educational value of video as a communication and learning tool • Learn to operate basic multimedia equipment: camera, microphone, lights, etc. • Plan, record, and edit a short video with clear storytelling • Explore basic video and sound editing using CapCut and OBS Studio • Reflect on the importance of media in presenting innovation projects
Key STEAM Elements	• Science: understanding how sound and image recording work • Technology: multimedia tools, OBS Studio, CapCut • Engineering: understanding hardware integration (audio/video) • Arts: storytelling, sound design, visual presentation • Mathematics: time management and sequencing during editing
SDG/ Sustainability / Cultural Heritage Focus	• SDG 4 – Quality Education • SDG 9 – Industry, Innovation and Infrastructure • Encourages digital creativity, communication, and media literacy as part of inclusive innovation and education
Materials / Resources Needed	• Video camera or smartphone • Microphone (integrated or separate) • Tripod, lighting setup, and/or optional green screen • Audio and video mixer (if available) • A computer with internet • OBS Studio (free software) • CapCut (free editing software) • Script/storyboard sheets • Headphones, speakers • Web studio or recording space (if available)

Description of Specific Activities	**Step**	**Description of the activities**	**Duration**
	Feel:	Students explore how video is used in daily life and reflect on how it can be used to communicate innovation. The teacher introduces the school's recording equipment and discusses setup options (audio, camera, lighting). Students learn	60 - 90 min

		about OBS Studio and how it allows synchronized audio and video capture.	
	Imagine:	Students plan their video and write a script based on the product that they created earlier. They decide the format (horizontal or vertical), the platform to share it (YouTube, Instagram, TikTok), and technical aspects such as angle, framing, and whether to use a green screen.	45 - 60 min
	Create:	Students rehearse and record their video using school equipment and OBS Studio on the computer. They transfer footage to the computer and begin to edit the video with CapCut. They can add music, transitions, effects, titles, and adjust audio levels. Students rewatch and refine their work until they are satisfied.	120 min or more
	Share:	Final videos are exported and presented to classmates, shared online, or shown in school. Students give each other feedback, reflect on the process, and discuss what they've learned about communication, planning, and editing.	45 - 60 min
Follow up activities (if needed)	● Students can publish their videos on school platforms or social media ● Organise a video showcase or mini film festival ● Challenge students to create a tutorial or documentary using the same tools ● Encourage use of video in other school subjects (science reports, storytelling, etc.)		
Assessment / Reflection / Feedback	● ASSESS assessment rubrics of collaboration, creativity and communication or other competences teachers find more suit to their context. ● Teachers might observe the students work on filming and editing phase		
List of Educational Material (presentations, videos, reading material, exercises/worksheets, references)	● OBS Studio Tutorial ● CapCut Tutorial ● CapCut Download ● OBS Studio Download ● **Please read the complete Lesson Plan here**		

4.8 Lesson Plan 7

Title	Vector Graphics Design

Duration	3 hours
Specific Learning Objectives	● Understand the role of vector graphics in modern design ● Learn to use vector graphics for creating scalable digital artwork ● Explore key design principles: color, shape, balance, and typography ● Apply vector techniques to create logos, icons, or posters ● Develop creativity, visual communication, and digital skills
Key STEAM Elements	● Science: Observation and analysis of form, structure, and color relationships ● Technology: Use of vector design software ● Engineering: Visual problem-solving and layout construction ● Arts: Creative expression through illustration, typography, and color ● Mathematics: Applying symmetry, proportion, scaling, and vector geometry
SDG/ Sustainability / Cultural Heritage Focus	SDG 4 – Quality Education: Fosters digital creativity and expression SDG 12 – Responsible Consumption and Production: Promotes virtual creation over printed materials Cultural Heritage: Encourages students to represent local identity or cultural values through design
Materials / Resources Needed	● Computers with Inkscape installed: https://inkscape.org/ ● Internet access for tutorials and examples ● Sketchbooks or paper for planning ● Projector (for gallery walk)
Description of Specific Activities	**Step** / **Description of the activities** / **Duration** Feel: Students explore where vector graphics appear in daily life and why they matter., and discuss on how design conveys meaning. — 30 min Imagine: Students brainstorm and sketch ideas, logos, posters, icons, or illustrations based on causes, identities, or themes they care about. They explore examples and get familiar with Inkscape's interface. — 30 min Create: Students build their design in Inkscape, using essential tools like color, path — 90 min

		operations, text, alignment, and bitmap tracing.	
	Share:	Projects are displayed digitally in a "gallery walk." Peers give quick feedback on what they liked, the message they received, and one suggestion. The class reflects on design and self-expression.	30 min
Follow up activities (if needed)	Create an online gallery for the classroom artwork.		
Assessment / Reflection / Feedback	● ASSESS assessment rubrics of collaboration, creativity and communication or other competences teachers find more suit to their context. ● Student presentations and reflections		
List of Educational Material (presentations, videos, reading material, exercises/worksheets, references)	Introduction to Vector Graphics The principles of design Inkscape – Official Website Inkscape – Official Tutorials Inkscape Tools Overview Playlist Inkscape Logo Tutorial Bitmap Tracing in Inkscape		

5 ANNEXES

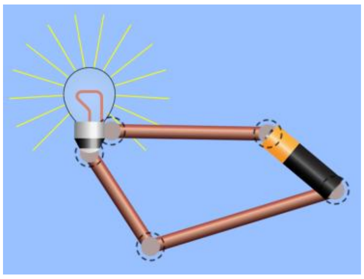
5.1 Lesson Plan 1 - Electronics I

FEEL	Electronic circuits are ubiquitous in our daily lives, from phones and home devices to public services, such as healthcare and transportation systems. They are crucial because they enable communication and a good quality of life. Understanding them and being able to create electronic circuits is important not just for technological advancement but also for artistic expression and interactive art. Engage your students with the topic through videos or other resources about electronic applications and their impact on our daily lives. You can also stimulate discussions by asking questions such as: ● How might understanding circuits shape our future? ● How have electronic circuits changed our daily interactions with each other and with science, technology, engineering, arts, mathematics, history, languages, philosophy, etc? ● How can knowledge about electronic circuits be applied to arts and creative expression in general? ● What benefits does it bring to our community? After exploring the topic in small groups, have students connect concepts, share personal insights, and consolidate their thoughts by summarising what they learned through visual representations or mind maps.
IMAGINE	Electronic circuits can stimulate our imagination and enable the creation of interactive art installations or performances that respond to environmental factors such as sound or body movement. Projects like these support the development of technical skills and creative expression, encouraging students to explore the relationship between different fields and understand how they are intrinsically connected. The first step is to learn how electric circuits work. It is time to use your imagination! Online laboratories are great because they provide interactive

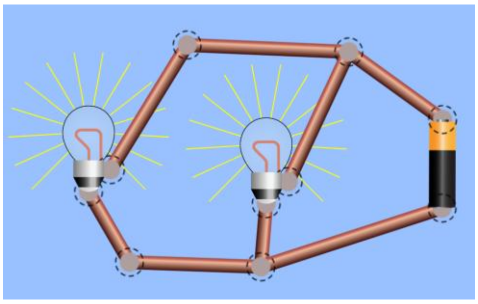
simulations and hands-on experiences that allow students to experiment with circuits and different components in a safe, accessible environment. For example, students can be encouraged to explore the PHET Circuit Construction kit, or others similar tools.

The following practical exercises using the PHET Circuit Construction Kit will get your students introduced to electronics concepts:

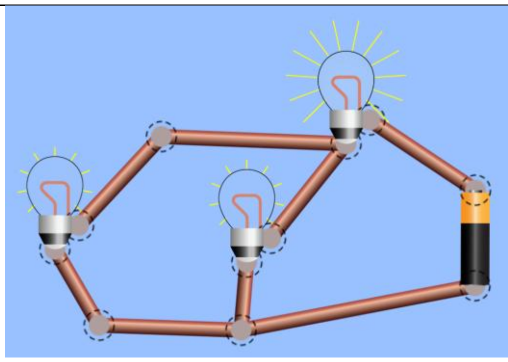
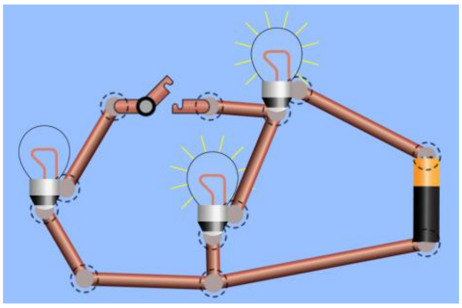
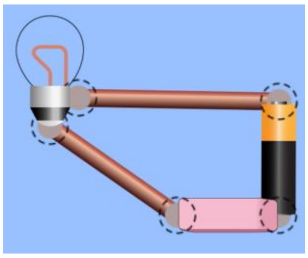
- **Simple Series Circuit:** Connect a battery, a resistor, and a light bulb in a single loop to demonstrate how current flows through components in series. **Try changing the battery's voltage to see what happens to the light bulb.**



- **Simple Parallel Circuit:** Create a circuit with multiple light bulbs connected in parallel to show how each bulb operates independently and how the total current is divided among them. **Use a multimeter to measure the output voltage in different parts of the circuit.**



- **Series-Parallel Circuit:** Combine both series and parallel components by connecting some bulbs in series and others in parallel to explore how different configurations affect brightness and current flow. **There are many configurations you can try out.**

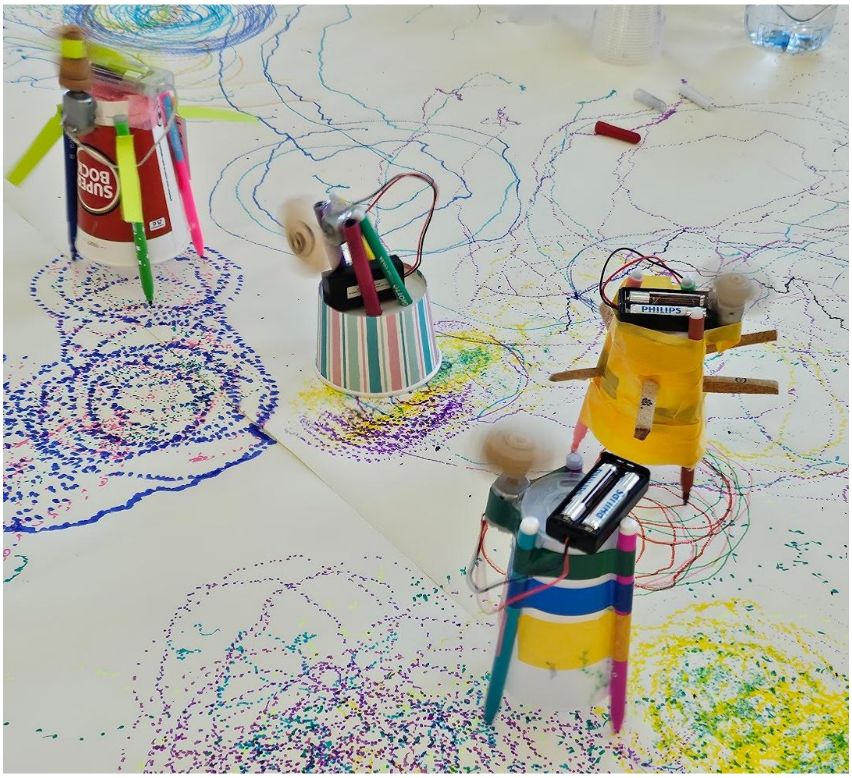
	 ● **Switch-Controlled Circuit:** Add a switch to a circuit with a light bulb to illustrate how opening and closing the switch controls the flow of electricity and the operation of the bulb. **Try placing the switch in different positions in the circuit and observe which bulbs are lit when the switch is pressed.**  ● **Circuit with a resistor:** Build a circuit with a resistor to learn the importance of using resistors to prevent damage. **Try out different types of materials.**  These experiments aim to acquire the skills to imagine and plan how electronic circuits can be used creatively.
CREATE	We provide instructions for creating a (1) painting robot, a (2) electronic postcard or a (3) electric car. Students are organised in groups. They can choose from one of these activities or from [other examples](). All of them

follow the same logic in their circuitry and can be easily adapted to other creative purposes.

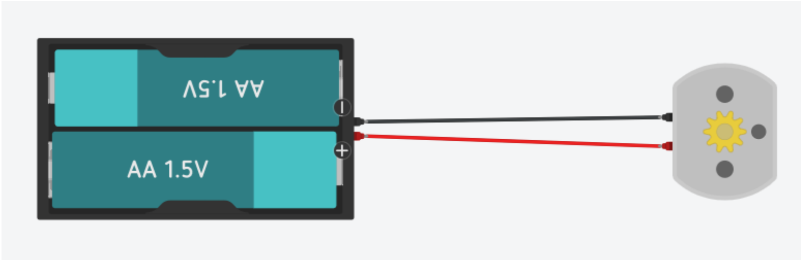
1. How to build a painting robot

There are many simple ways to build a painting robot. Watch this video or read this page for instructions and to understand the basic concepts behind it.

You don't have to use the exact same materials. For the robot body, you can use anything you want, from cardboard boxes to plastic cups or bottles. It can be decorated with anything you wish. Be creative!



The way it works is very simple! The robot will move when it becomes unbalanced. This happens when the DC motor is connected to a part of its body that moves, causing an uneven distribution of weight. The circuit is very straightforward as well:



Since the DC motor is a bipolar electronic component, it will rotate regardless of how it is connected. However, it will rotate in the opposite direction if connected the other way.

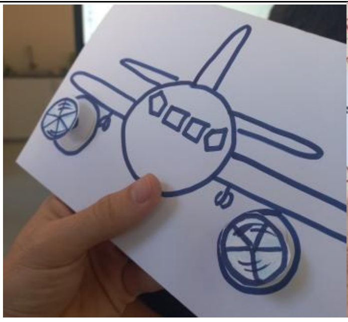
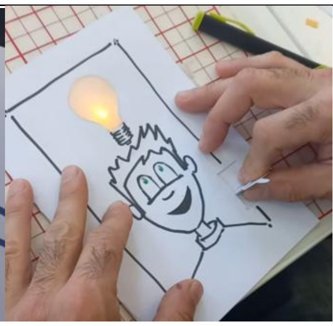
2. How to create an Interactive electronic postcard

There are many ways to create an interactive electronic postcard. Watch this video for detailed instructions, and use your knowledge and creativity to create your postcards.

Although the video doesn't show any resistors in the circuit, consider using them to prolong the life of your LED bulbs. Consider Ohm's Law, expressed as V = RI. When the resistance in a circuit is approximately zero, the current (I = V/R) can become virtually infinite, since any voltage divided by a very small resistance results in a very large current. This can potentially damage the circuit and significantly reduce the lifespan of the LED.

Consider using other electronic components as well to create more diverse postcards. Small DC motors can be used to create movement. Reed switches, photoresistors, flame sensors and others can also be used to trigger an LED, a small DC motors, or multiple LEDs.

Don't focus solely on the science aspect of the activity. Take the opportunity to explore various artistic techniques as well and unleash your creativity.

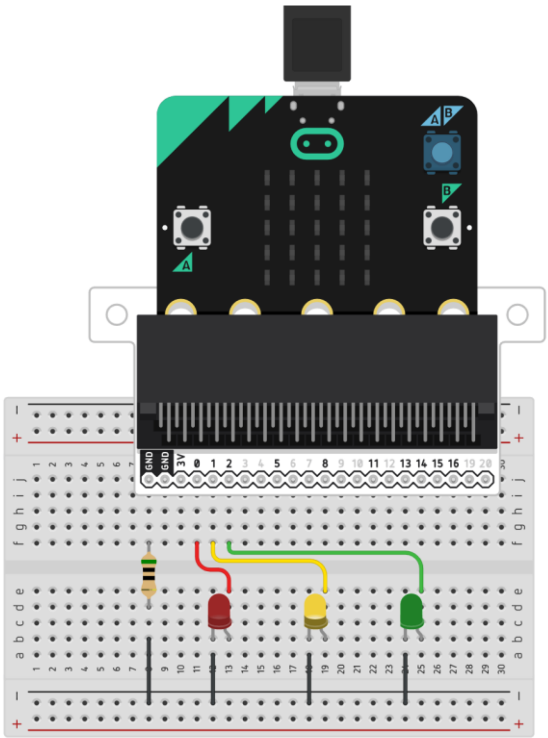
	 **3. How to create an electric car** There are many simple ways to create an electric car with a DC motor and a battery. [Watch this video](). The electric circuit is the same as the one for the robot, but a different shape, and wheels connected to the motor through a transmission chain.
SHARE	It is time for students to share and reflect on their projects. Each group takes turns presenting their work to the class explaining the creative aspects of it, as well as how it works and can be further improved. After all groups have presented, students circulate around the room, observe other projects, and leave one positive comment or question on a sticky note at each table. This encourages peer-to-peer feedback in a supportive and engaging way. To conclude, the class comes together for a short reflection. Students are invited to discuss how electronics and art were and can be combined in the future, and what they learned from each other, including from the challenges that each group had to overcome to complete the project.

5.2 Lesson Plan 2 - Electronics and Programming I

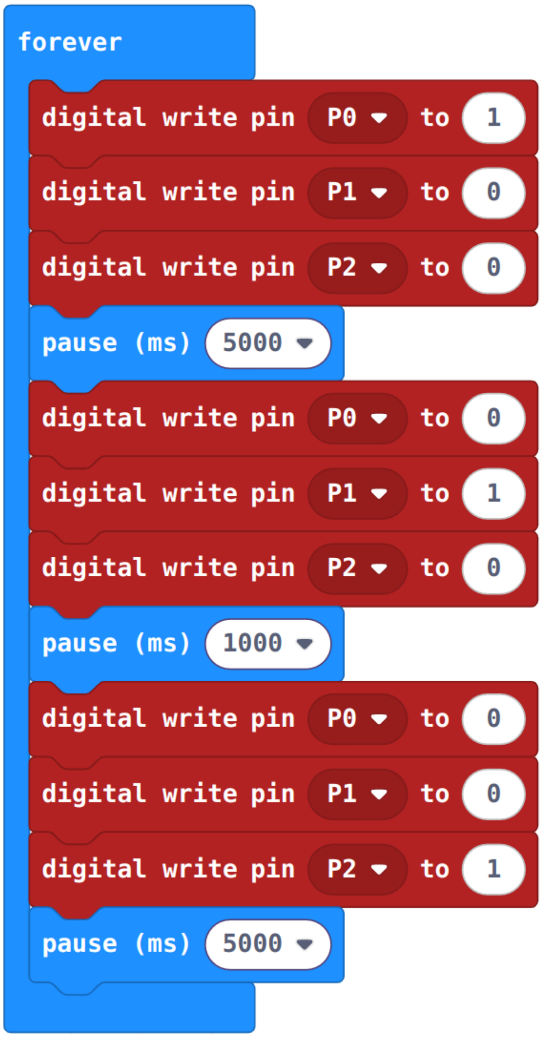
FEEL	Electronics and programming are an integral part of our daily lives, influencing everything we do in today's society and our interactions with others. They not only make smartphones and computers work, but they are also essential for transportation, healthcare services, banking services,

	entertainment, education, science, arts, etc. Understanding electronics and programming and being able to write code are important not only for technological advancement but also for fostering creativity, autonomy, critical thinking and innovation in various fields. Engage your students with the topic through videos or other resources showcasing electronics and programming applications and their impact on our daily lives. You can stimulate discussions by asking questions such as: ● How can these technologies shape our future? ● How have they transformed our interactions and influenced fields like science, engineering, the arts, mathematics, history, languages, and philosophy? ● How can knowledge of programming and electronics be applied to creative expression and artistic projects? ● What benefits does it bring to our community? Investigate what devices and programming languages, and tools are the easiest to learn and most suitable for educational projects. A thorough research will likely lead to the discovery of the micro:bit microcontroller, which is one of the best options available for educational robotics, electronics, and programming. After exploring the topic in small groups, have students connect concepts, share personal insights, and consolidate their thoughts by summarising what they learned through visual representations, mind maps or other tools.
IMAGINE	Electronics and programming can stimulate our imagination and enable the creation of interactive art installations or performances that respond to environmental factors such as sound or movement. Projects involving arts, science, technology and other fields support the development of technical skills and creative expression, helping students to understand the interconnectedness of different fields.

	The first step is learning how to program a microcontroller. This lesson uses the micro:bit microcontroller. The micro:bit can be programmed online with Makecode without the need to install any additional software on your machine. This online platform also allows you to simulate the programs before they are downloaded to the micro:bit, which makes it easier to test them. Organize students in groups. The following Suggested tutorials will get them familiarized with most of the micro:bit sensors and many import code blocks: Beating Art Compass bearing Thermometer Sound level meter Step counter Light sensor More tutorials. Give your students time to explore by themselves and write their programs. There are many other similar interesting tools online to learn electronics and programming, such as Tinkercad, Scratch, and Makeblock, and students should be encouraged to explore them. Check out other **Example projects**.
CREATE	As a first step towards understanding how to use microcontrollers to control other electronic components, this lesson provides instructions to build a traffic light system, and then shows how to adapt the same circuit to other purposes. Before starting have the students organized in small groups, each with an electronic kit.

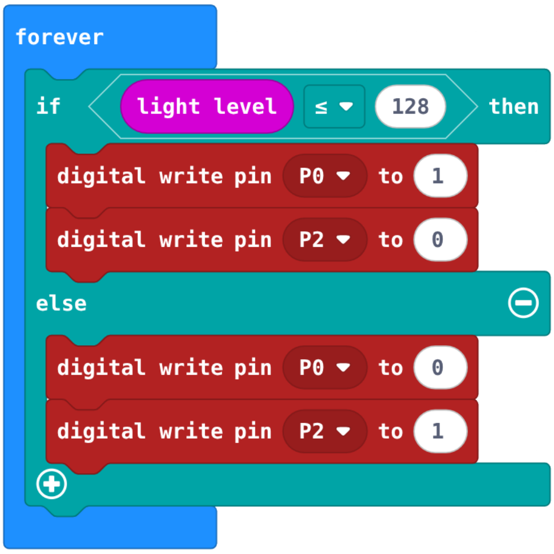
	1. How to build a traffic light system There are many ways to build a traffic light system. Here we provide instructions for a traffic light system with the micro:bit. If you don't know how to use a breadboard to connect your electronic components check out this video. First you need 3 LEDs connected to the micro:bit on three different digital ports (PINS), for example 1, 2 and 3. Note that the circuit must be closed, so the LEDS must also be switched on or off. A resistor will prevent any damage to the LEDs. The program must control when each LED lights up.  To control the LEDS, you need to use the blocks in the Pins category in Advanced.

	 The digital write block is used to turn on/off (1 or 0) port P0 or another selected port, and therefore to activate/deactivate whatever is connected to that port. The analog write block is used to turn on the selected port as if it were a tap, between the values 0 to 1023. If you connect an LED with this block, you can control the intensity of the LED by choosing the "flow in the tap". In this case, we'll use the digital write block to decide which LEDs are on and off at any given time. For example, 5 seconds for the red signal, 1 for the yellow signal and 5 for the green signal.



2. Adapt the circuit to other purposes

Each group will now adapt the same circuit to different purposes. For example, the light sensor can be used to detect someone's presence through their shade on the micro:bit and trigger a red light, or otherwise yellow.

	 Only the code needs to be changed. Different and multiple sensors can be used to trigger events. Encourage students to be creative and use their imagination to create something new.
SHARE	Students will participate in a "Project Swap". Each group leaves their project at their station with a brief written state of purpose. Groups then rotate around the room, trying out each other's projects, interacting with them and trying to guess how to use them. As they do it, they write down short "review cards" highlighting what they liked, surprised them, or a question. After which, students return to their own stations, read the feedback, and discuss as a class what they discovered by seeing their projects through someone else's eyes. This playful, hands-on approach encourages curiosity, active engagement, and deeper appreciation of both technical and artistic work.

5.3 Lesson Plan 3 - 3D Modeling and Printing I

FEEL	These days, technology is much more accessible to everyone. One of these accessible technological processes is 3D modelling and printing that are complementary processes witch allows the creation of three-dimensional objects from digital designs. 3D modelling is the process to create a digital object with specialised software and 3D printing is the method to transform

	this digital model into a physical object with the application of material in successive layers (additive manufacturing). The teachers can begin this lessons with the explanation of what 3D modelling and 3D printing are; The process to create models with shapes, sizes, forms in a tree dimensional space in a computer softwares is called 3D modelling. The 3D printer is a machine that uses these virtual 3D models and transforms them into a real-world object with melted materials (plastic filaments for example) applying them layer by layer. Students can experience that something they can design on a screen can be transformed into a physical object that they can touch and use. We recommended that teachers use a selection of short videos to help to build students' curiosity. These videos highlight real-world examples of 3D printing in action, such as the creation of prototypes, educational tools, buildings, prosthetics, and even the printing of human organs. Example Videos: ● What Is 3D Printing? ● The Race to 3D-Print Our World ● How Concrete Homes are Built with a 3D Printer ● 3D-Printing Heart Tissue With Human Stem Cells ● World's Largest 3D Printed Boat ● The World's Very First 3D-Printed Bridge is Open in Amsterdam ● 11 USEFUL Things to 3D Print First Show to students how powerful this technology is, show them that it is something they can use themselves to create, solve problems, imagine new possibilities. This phase is about inspiring students. You can also stimulate discussions by asking questions such as: ● Imagine you drew a simple sketch. How would it feel to see that drawing become a real, touchable object? ● What's one everyday item you'd love to redesign or improve through 3D printing? Why does that idea excite you?

	• How do you think it could change your view of technology if you could hold in your hand something you created entirely on a computer? • If you could print any toy, tool or gadget, what would it be? • Can you think of a problem at home or school that a 3D-printed solution might help solve? How would that solution make you feel? • When you hear "additive manufacturing", what images or feelings come to your mind? Why do they interest you? Explore the topic in small groups, make students connect concepts and share their personal insights. Try to Summarise what they have learned through visual representations or minde maps to consolidate their thoughts.
IMAGINE	When students imagine a 3D printed object, they can blend practical design with personal expression. They are encouraged to explore how geometry, text, math, creativity and purpose come together in a model, which helps them see the connections between digital tools and real-world problem solving. Students can be encouraged to imagine what they could create and teachers can guide a brief reflection: What kind of object could we make together? How can we turn a simple idea into something useful or personal? The class agrees to create a custom keychain, a small object that is both practical and a great introduction to 3D design. Students begin to visualize what their keychain might look like: What shape will it be? What word or name will they include? What colours or styles would they like if it were possible? Students are not on the computer yet; This phase is focused on imagination, planification, and purpose. Now is the time to think, discuss, sketch ideas if needed, and prepare mentally for the hands-on creation that comes next.
CREATE	On this phase, teachers should feel confident with the basics of TinkerCAD tool, a free and beginner-friendly platform for 3D modelling. A helpful overview can be found in this video tutorial: TinkerCAD - Tutorial for Beginners in 9 MINUTES! [COMPLETE]. Once comfortable with the

	platform, teachers can seamlessly support each student as they bring their ideas to life. It's recommended that students watch this video tutorial too, so they can be more familiar with TinkerCAD. Now is time to enter the creation phase and bring students' ideas to life with the use of TinkerCAD. Enter on TinkerCAD Portal and do your login. Teachers can demonstrate the main tools of TinkerCAD. Show them how to use basic shapes, resize and move objects, align objects, etc. Each student can now begin to model their own personalised keychain with teachers guidance. They can select a base shape, adjust its size (such as 8x10 cm, with 5 mm height), and then add a text element (like their name or initials) on top of the base, but ensures that the text is joined to the base so that it prints correctly. Dont forget to add a hole on the keychain that allows the keyring to be attached later. Once the models are complete, the next step is preparing them for printing. Before this step, the teacher must know the basics of the Orca-Slicer application. For that, please vizualized this tutorial video: Orca Slicer Getting Started Guide: A slicer for all of your 3D printers The class can be introduced to Orca-Slicer, a program that converts the 3D model into instructions the 3D printer can follow. The teacher explains how to import the model and shows some of the basic settings: ● Infill density (how solid the print will be) ● Speed of printing ● Whether or not to use supports for overhangs The teacher can also introduce different types of filament (like PLA, PET-G, and TPU), explaining their characteristics in a simple way. For this step, the teacher can be prepared by this video: The 5 Filament Types You Need to Know (And What They're Good For)

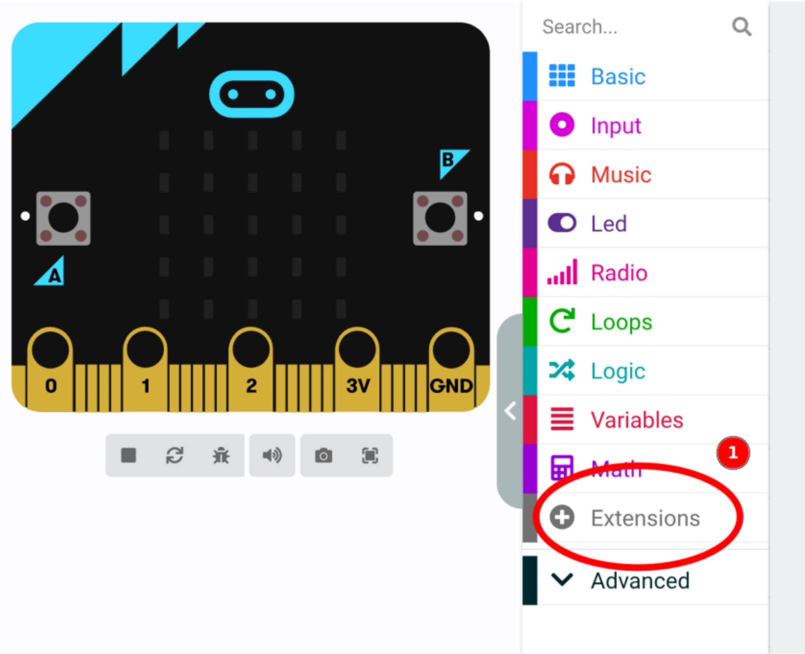
	After all settings are configured, the model is sliced, and a G-code file is created. This file will be sent to the 3D printer for the final stage. All activities should be documented in photo, video, and/or other formats for sharing and demonstrating their impact.
SHARE	Before the final print process, the teacher should be comfortable with the operation of their own 3D printer (loading filament, preheating, and selecting files) so they can confidently support students during this moment. Please read your 3D printer Manual or search for tutorial videos for your 3D printer. In this phase, students will see their digital creations become physical objects. Together, they move to the 3D printer and learn how to prepare it. They will learn how to load the filament, heat the bed, and select the G-code file to print their 3D Models. The class will watch the print process begin and observe how their design is printed layer by layer. Once completed, each student receives their own 3D-printed keychain. This moment is may be filled with excitement, pride, and a sense of accomplishment, but maybe some frustration, because what they did will not work/look good in real life. To conclude, the teacher can encourage students to share their experiences by asking some questions, like: What did they learn? What did they enjoy most? Would they change or improve anything in their design? What frustrated them most? This sharing moment helps consolidate learning and builds a sense of community among young makers.

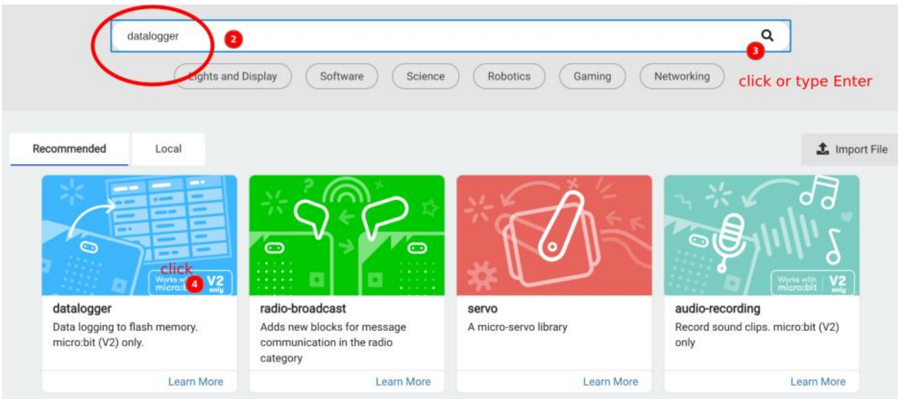
5.4 Lesson Plan 4 - Electronics and Programming II

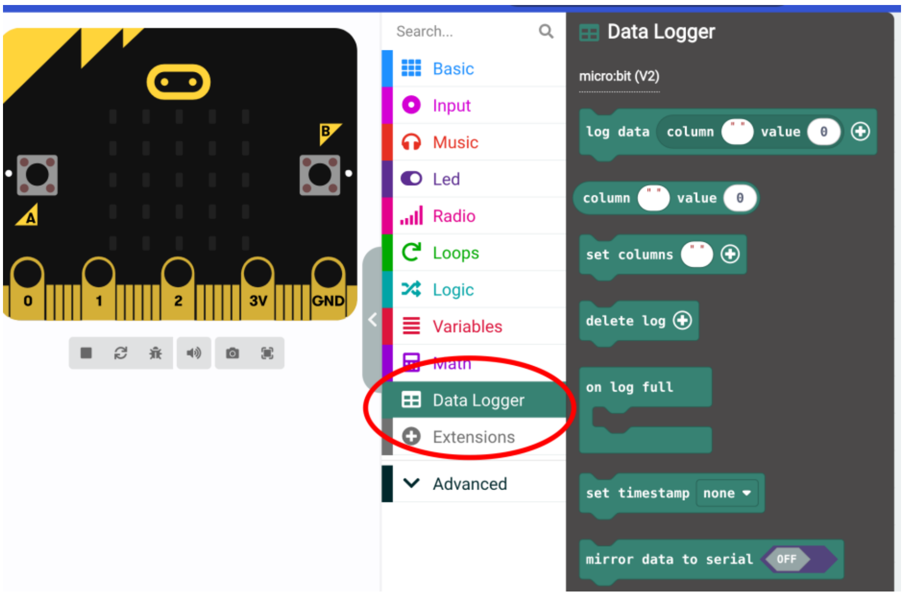
FEEL	Electronics and programming are an integral part of our daily lives, influencing everything we do in today's society and our interactions with others. They not only make smartphones and computers work, but they are also essential for transportation, healthcare services, banking services, entertainment, education, science, arts, etc. Understanding electronics and programming and being able to write code are important not only for technological advancement but also for fostering creativity, autonomy, critical thinking and innovation in various fields. Engage your students with the topic through videos or other resources showcasing electronics and programming applications and their impact on our daily lives. You can stimulate discussions by asking questions such as: ● How can these technologies shape our future? ● How have they transformed our interactions and influenced fields like science, engineering, the arts, mathematics, history, languages, and philosophy? ● How can knowledge of programming and electronics be applied to creative expression and artistic projects? ● What benefits does it bring to our community? This is also the moment to investigate what devices and programming languages, and tools are easiest to learn and most suitable for developing educational projects. A thorough research will likely lead to the discovery of the micro:bit microcontroller, which is one of the best options available for educational robotics, electronics, and programming. After exploring the topic in small groups, have students connect concepts, share personal insights, and consolidate their thoughts by summarising what they learned through visual representations, mind maps or other tools.
IMAGINE	Electronics and programming can stimulate our imagination and enable the creation of interactive art installations or performances that respond to

	environmental factors such as sound or movement. Projects involving arts, science, technology and other fields support the development of technical skills and creative expression, helping students to understand the interconnectedness of different fields. The first step is learning how to program a microcontroller, such as the micro:bit. The micro:bit can be programmed online with Makecode without the need to install any additional software on your machine. This online platform also allows you to simulate the programs before they are downloaded to the micro:bit, which makes it easier to test them. Organize students in groups. The following Suggested tutorials will get them familiarized with most of the micro:bit sensors and many import code blocks: Beating Art Compass bearing Thermometer Sound level meter Step counter Light sensor More tutorials. Give your students time to explore by themselves and write their programs. There are many other similar interesting tools online to learn electronics and programming, such as Tinkercad, Scratch, and Makeblock, and students should be encouraged to explore them. In this lesson we suggest using sonification to combine arts science and technology in one interactive device able to measure environmental

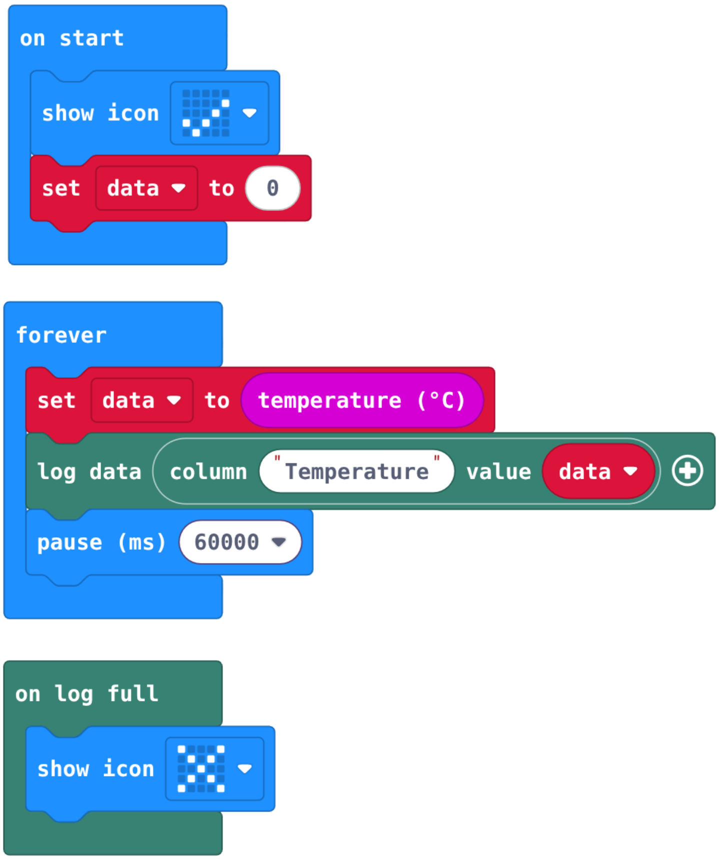
	parameters such as light, temperature, etc, and transform the data into sound. **Why sonification?** Sound conveys information that is readily accessible to you through mere observation of your body sensations. But did you know it is also possible to "hear the stars", the brain waves of someone thinking, or even plants "talking to each other"? The process of translating data, like voltage fluctuations, colour brightness, light frequencies, or any kind of data, into sound is called sonification. Auditory representations of data offer intuitive understanding and can reveal patterns not easily discernible visually. But besides its aesthetic appeal to students in general, data sonification enhances accessibility for the visually impaired, fostering inclusion in the classroom. This innovative method aims to enhance student engagement and motivation while promoting inclusion, diversity and competence development. Through exploration of the auditory sense, students will learn to communicate and connect using the universal language of music. To learn more about sonification, take a look at the SoundScapes project resources.
CREATE	This lesson will use temperature measurements but you can use any of the other micro:bit sensors. Sonification of temperature measurements can be made in different periods, locations, or scientific experiments. The first step is to create a micro:bit thermometer that registers the temperature every minute, hour, or day - whenever you find it relevant. But first, you need to install the datalogger extension for Makecode.


Search...
Basic
Input
Music
Led
Radio
Loops
Logic
Variables
Math
Extensions
Advanced
1
0
1
2
3V
GND
A
B

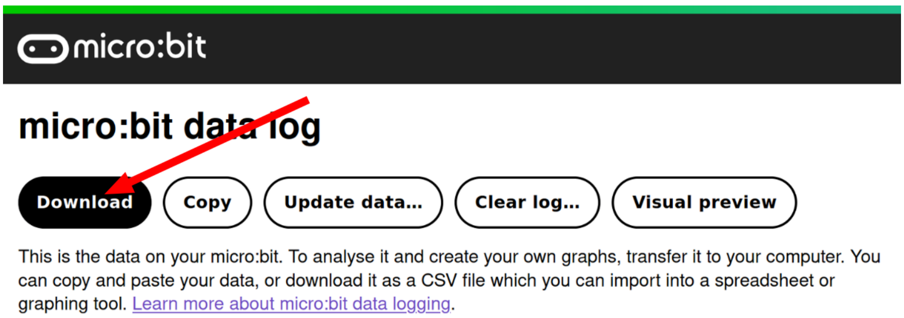

datalogger
2
3
click or type Enter
Lights and Display
Software
Science
Robotics
Gaming
Networking
Recommended
Local
Import File
click
4
datalogger
Data logging to flash memory. micro:bit (V2) only.
Learn More
radio-broadcast
Adds new blocks for message communication in the radio category
Learn More
servo
A micro-servo library
Learn More
audio-recording
Record sound clips. micro:bit (V2) only
Learn More


Search...
Basic
Input
Music
Led
Radio
Loops
Logic
Variables
Math
Data Logger
Extensions
Advanced
Data Logger
micro:bit (V2)
log data column value 0
column value 0
set columns
delete log
on log full
set timestamp none
mirror data to serial OFF

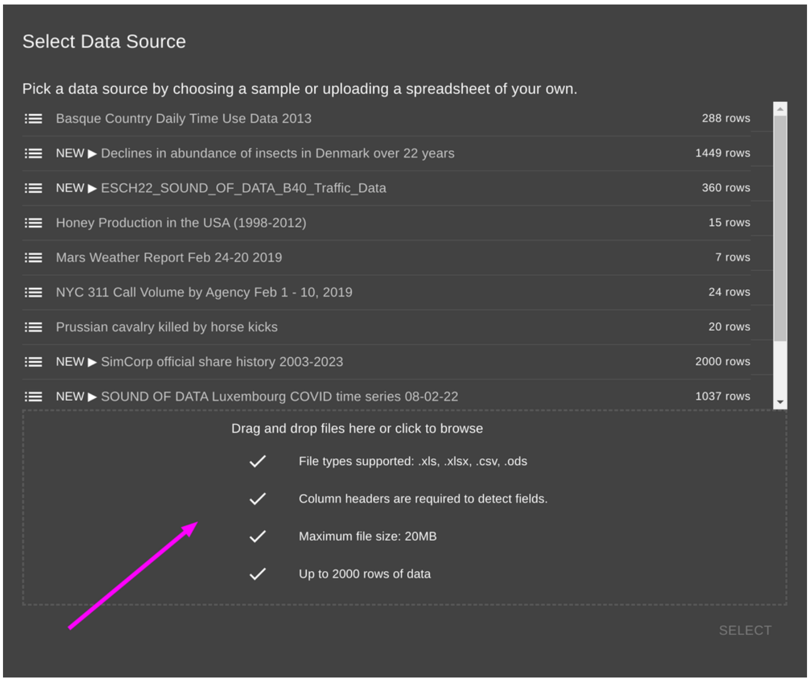
The datalogger extension will appear in your categories list. If you have already gone through the thermometer tutorial, it is easy to adapt it to register the temperature.



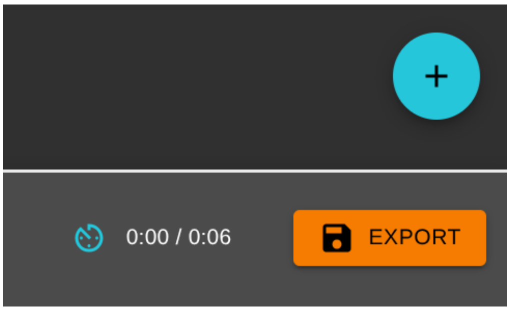
The code will register the temperature every minute until the micro:bit internal log file is full. To access the log file open the micro:bit in you file explorer/manager and open the file **MY_DATA.HTM,** and click **Download**.



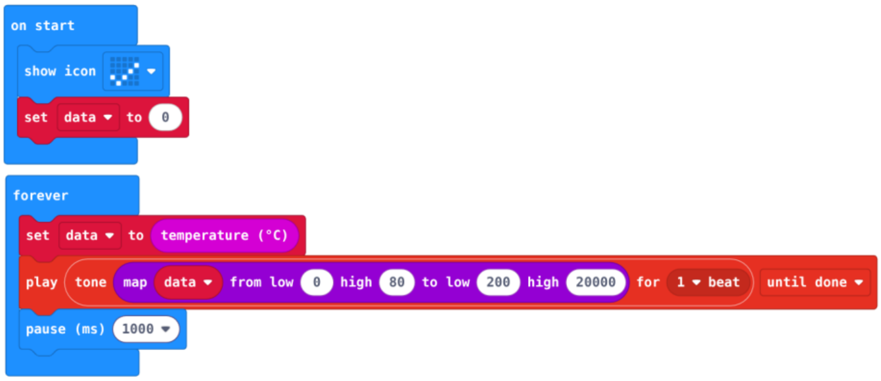
After downloading the file, you will need to use the online software TwoTone tool to listen to the data. After opening the website, you will be presented with a window to select your data source. Upload your file to the rectangular box, either by clicking it and browsing your local folders or by dragging the file into it:



Watch this video to see how the software works. To export your sound file, click the button Export in the bottom right corner.

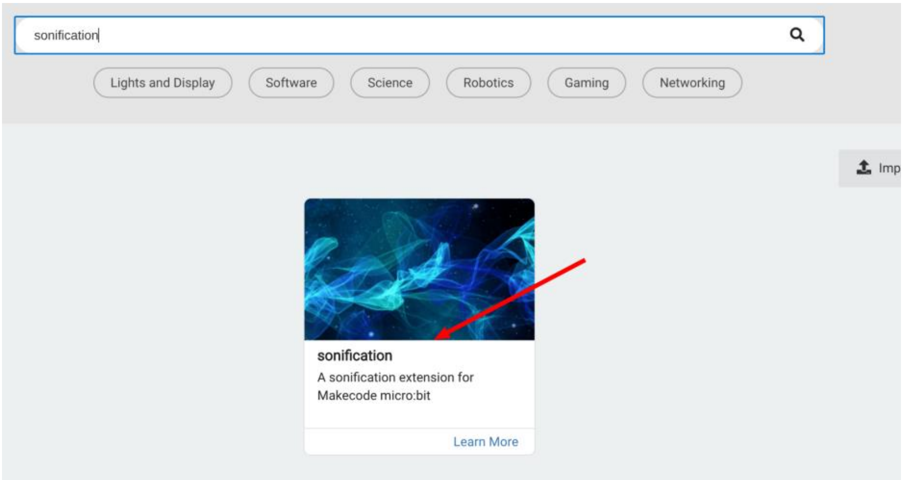


You can also play the data directly with micro:bit in real-time, for instance, every second:

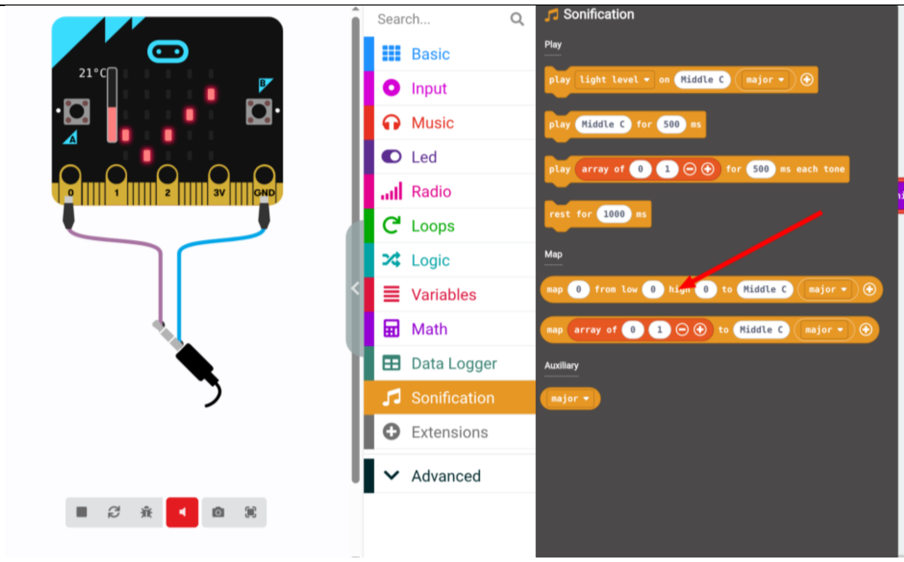


The map block found in the math category will map the temperature data measured between the minimum and maximum values that the temperature sensor can handle to the range of frequencies that humans can hear. The Play block will play the resulting frequency for one beat.

Alternatively, you can play the temperature mapped to a music scale. To do that, you will need to install the sonification extension.



Now replace the math map function with the map function of the sonification extension.

<table>
<tr><td></td><td>


Now you can change the fundamental note of the scale, the scale itself and the number of octaves!

Think of how you can use this in other ways, or with other sensors. Be creative!
</td></tr>
<tr><td>SHARE</td><td>Students will create a “Data Jam” session. All group play their sonifications, first individually and then simultaneously, either using the micro:bit in real-time or their exported sound file from TwoTone. The classroom becomes a mini sound lab, where students listen to each unique “data melody” and take note of how different variables affect the sound. After each presentation, classmates try to guess what environmental patterns or times of day may be reflected in the sound. Once all groups have presented their projects, students discuss how data can be experienced through sound, how different interpretations emerge and its impact and value. This phase</td></tr>
</table>

	transforms technical work into a shared sensory experience, reinforcing both creativity and comprehension.

5.5 Lesson Plan 5 - 3D Modeling and Printing II

FEEL	Now we'll go beyond the basics of 3D modeling and printing with the goal to create something innovative that students can use, with the combination of various skills and competencies. Students may already know how to create simple 3D models and put them to print, if not, please do the Lesson Plan 3 first. Try to encourage students to reflect on the needs of the world around them, maybe ask some questions that can help them to reflect: What problems do they notice at school, at home, or in their community? What can they produce to solve these problems? Is there something they could create that would help someone? Can they fix something with 3D Printing? Or make a task easier or more fun? Is there any object that they use every day that can be improved? To support the reflection, the teacher can show a few short examples of innovative 3D-printed solutions: ● 12 BRILLIANT & INNOVATIVE 3D Prints That Make Life Easier ● Cool 3D Prints That Use GRAVITY & PHYSICS ● Unique Functional 3D Prints I Use Every Day ● 5 Practical Camping 3D Prints That Actually Work These examples may include assistive devices, creative toys, simple robotics components, or objects made to hold or protect something valuable. Students can explore the Thingiverse portal to search for innovative 3D Models. The goal is to help students feel that they, too, can be inventors and that the tools they already know (TinkerCAD, OrcaSlicer, the 3D printer) can be used to create something new from their imagination.

	At this point, students also revisit what they know about basic electronics (circuits, batteries, motors) and block programming with micro:bit. The teacher explains that the object they design might include or support one of these components, or serve as the body or structure of a more complex invention, for example, a component of the electric car, a wearable item to use the Micro:Bit with lights. The purpose of this first phase is to create an emotional connection between the student and the challenge. The teacher helps students realise that they are capable of designing something useful and completely unique.
IMAGINE	In this phase, once students are engaged and inspired, they are invited to think like young designers and inventors. They reflect on possible ideas for a functional product that they could create using 3D printing. To help guide the ideation process, the teacher can offer a few suggestions for more advanced 3D modeling projects, such as: ● Create the structure for a robot or moving tool using a DC or servo motor. ● Design a chassis for a small electric car. ● Design a mobile phone or tablet stand with multiple angles, different stability, and functionality. ● Create a custom puzzle or articulated toy, which introduces students to the concept of movable joints and tolerance between parts. ● Build an organiser or container that serves a specific function, like a desk tidy or storage box with compartments. ● Design a mold (for example, for soap or chocolate) which introduces the idea of negative space and cross-disciplinary use; ● Create a wearable component for a micro:bit project. With lights and sensors, maybe moving parts? Or create a case for an electronic prototype. The possibilities are open!! Try to create an object that serves a purpose and demonstrates creativity and problem-solving.

	The teacher can encourage students to sketch their ideas on paper. Students could discuss the ideas in small groups. What is the object's function? What is its size? How will it be printed?, Which material to choose? Will it be used alone or in conjunction with other parts? How will the object interact with the real world? Does it move, light up, support something, or solve a problem? Each student or group should have a clear concept of what they want to build, which includes its purpose and a basic visual plan. The focus is to plan with intention, not perfection. Their ideas may still evolve in the creation phase, and that is part of the learning process.
CREATE	In the Create phase, students and teachers need to learn some advanced 3D modelling skills. Please watch these videos to learn more techniques: ● 5 must-know 3D printing tips & tricks. (stronger and better looking prints) ● Complex Shapes Tinkercad ● Make a 3D Print Out of Any Outline Image in Tinkercad ● How To Make: Mini Box Using Tinkercad For 3D Printing - Tinker Time ● How to Make a Bolt and Nut in Tinkercad That Really Work! ● Tinkercad: Creating An Articulated Model ● Simple ways to create your own 3D models for 3D printing In this phase, students already know the basics of the TinkerCAD platform and some advanced 3D modeling skills. Enter TinkerCAD Portal and do your login. The teacher can encourage them to explore more advanced tools and techniques. Some students may design a single solid object, like a stand or holder. Others may work on a structure with moving parts, a custom casing, or an enclosure that fits electronic components. The teacher needs to move around the room to support students, ask some questions and help them troubleshoot design challenges.

	Once the designs are ready, students export their files and open them on OrcaSlicer. With the teacher's support, they review the key printing settings (print speed, infill density, supports). Check if the model needs extra preparation to print well. When the model is ready, slice it and generate the G-code file. Put the G-Code file on your 3D printer and print it. If time allows, some models can be printed during class, and others can be queued for printing later. In this phase, the emphasis is to make, to create, but also on testing, adapting, and learning through iteration. Not all prints will be perfect, and that is okay. Students can learn from every step, and the classroom may becomes a space of experimentation, creativity, and teamwork.
SHARE	In the Share phase, teachers may encourage students to share what they have created. The teacher can organise a moment to share their creations, where students explain the purpose of their object. Some may demonstrate how their robot moves, how it lights up. Other students may describe how their creation can be a tool to solve a real problem at school or at home. Each presentation can be a chance to celebrate the final product, the process to create it, the idea and the challenges. Observe how students can be proud to make something from scratch. Put students to reflect and share: What worked well? What didn't go as expected? How did you solve problems? What would you improve next time? What did you learn about 3D design and printing? What did you learn about innovation? This final phase helps students see the value of sharing knowledge, the power to learn from mistakes, and the importance of communicating their ideas. It closes the learning cycle with confidence and meaning, preparing them to take their maker mindset into future projects.

5.6 Lesson Plan 6 - Video and sound editing and use of the web studio

FEEL	Video can be one of the powerful tools in education today that brings abstract ideas to life, supports visual and auditory learners, and gives us powerful ways to learn. Video enables students to have a meaningful learning experience and gives students a chance to have a creative voice to express what they've learned and to share it. For this lesson plan, students are introduced to the power of video as a creative and expressive tool. Teachers can put them to reflect on how video is used in everyday life these days (on YouTube, Instagram, TikTok, or school projects) to tell stories, present ideas, teach an audience and connect with others. We recommended that the teachers encourage students to think about what makes a video so engaging; is it the visuals? The music? The message? Or the way it's edited? Students are reminded that they have already worked on innovative product, but now, it's time to create a video to showcase their creation. What does their creation do? How was it made? What is its purpose? Why is it important?. They can ask these questions to engage students to feel: Who is this video for? What do you want people to feel when they watch it? How can you explain your idea clearly and excitingly? Students can visit the school's web studio (if available) to learn about the equipment they can use (video cameras, microphones, lights, green screens, audio and video mixers, and possibly a teleprompter). Make sure to understand the setup before any filming takes place. The audio will come from the camera's built-in microphone, or will a separate microphone be used? How will the sound be recorded and synchronised later if you use a separate mic? It depends on the equipment available; the sound might be recorded into a mixer and then sent to a computer, or recorded separately and added during editing. With the objective of allowing video from the camera and audio from the mixer to be captured at the same time on a computer, the teacher

	introduces the open-source software OBS Studio. Students watch a short tutorial on how to use OBS Studio to understand how to configure their recording setup effectively. This phase helps students recognise that videos are not just spontaneous, they require planning, technical setup, and creative intention. They begin to understand the full scope of storytelling through media.
IMAGINE	In this phase, students might have explored the equipment and the purpose behind their video; they are ready to plan their video content. The first step is to define the message. For that, try to ask these questions for your students: What do they want to communicate? They may decide to create a presentation video of the innovation they developed in previous lessons. Please encourage your students to highlight what problem their project solves, how it works and what makes it original. With the teacher's guidance, students might write a script of their video. This step will help them to organise their thoughts, plan the sequence of scenes, and maybe decide who will appear on screen and what will be said. Will the video be filmed in horizontal or vertical format? If the video is meant for YouTube, horizontal is more appropriate. If it is for Instagram Reels or TikTok, vertical is best. At this point, students decide where the video will be published and who the audience will be. This influences their tone, visual style, and technical choices. Please decide what kind of shots they will need. Will there be close-ups? Will they film someone talking? Will they show the product in action? Will they use a green screen? This phase will finish when students have their plan ready. Now it will be easy to produce a video that has good storytelling. The goal is to capture the essence of their invention in a short but good story.
CREATE	Let’s transform the classroom into a production studio!! To begin, Students will set up the equipment to record the video. Make sure to know how to use a camera, microphone, lighting, and any accessories like the green screen or teleprompter. Put all equipment in its place to have a good angle and test if all is working well. Check if the speaker (or object) is centred in

	the frame. Anything you are recording needs to be visible and with good focus, and don't forget to have good lighting. If a separate microphone is used, students need to follow the correct process to record high-quality audio to ensure it can be synchronised later. Video and audio can be recorded together in sync on the computer if you use OBS Studio. Students can watch the OBS Studio tutorial here. With the tutorial, they will better understand how to use the software effectively. Make sure to rehearse the script and camera positions before any recording. First, think about the background, camera angles, clarity of speech, and the timing of each part. Once everything is ready, students can start recording the video in one or more takes. Check the quality after each try to have good videos for the editing part. If you need to illustrate different parts of the story, you can record additional voice-over audio or extra footage (called "B-roll"). When you have all your recordings made, you can transfer the video files to a computer via the memory card of the video camera. We will use CapCut to edit the video. CapCut is a free video editing application very easy to use for beginners. To learn how to use CapCut, please first watch the CapCut tutorial here. First, use this website to download and install the CapCut application on your computer. Open the CapCut application to start video editing. Import all your recorded videos to CapCut, as the tutorial teaches. Students can now start to select and organise the recorded videos in the timeline. Cut them where needed, remove mistakes, add transitions, sound effects, music, texts and titles. Maybe put some text if you want. The details are important; adjust audio levels so that the background music doesn't overpower the speaker's voice. Listen all the audio to feel if the volume is good to understand everything. If students used a green screen on the recording, make sure to replace the background with CapCut's built-in tools. Encouraged your students to review their video multiple times. Does it flow well? Is the message clear? Does the final result reflect the innovation we created? Once satisfied, press "Export" to create the final video file.

SHARE	Now is the time to share the final video with the audience. How students want to share it? They may choose to upload it to video platforms like YouTube or upload the video on other social media like TikTok, Facebook or Instagram. Or maybe they prefer to present it to their classmates, teachers and/or families. It's good for students to have a moment of reflection on what they made. Try to ask them these questions: What did you enjoy most about creating this video? What was challenging? How did you solve problems along the way? What did you learn about storytelling? What is the most important part of recording a video? What have you learn about editing videos? It's recommended that the teachers show all the videos created to all the students so that students can comment on each other's videos. Try to have some feedback from the other students at the end of each video. Make sure to celebrate each project's uniqueness!! To share is not only to show a finished product, but is about communicating an idea and maybe inspiring others. Students might see themselves now as content creators and storytellers, a person who can bring their ideas to life connecting them to a wider audience.

5.7 Lesson Plan 7 - Vector Graphics Design

FEEL	Design is everywhere, in the clothes we wear, the websites we visit, the posters we see, and the products we use. Vector graphics are especially important in digital design, because they are infinitly scalable and easy to manipulate, allowing the creation of visuals logos, icons, and illustrations than can be used anywhere. Introduce the topic to students through videos explaining the importance of vector graphics and give with examples of logos and visual identities used

	by famous brands, community projects, or associations. You can stimulate discussions by asking questions such as: ● What is the role of digital tools in modern design, including in science, technology, engineering, arts and mathematics? ● How do vector graphics relate to mathematics? ● What makes the design of a logo memorable? ● How do colors, shapes, and fonts communicate meaning? ● How can we them to communicate our intentions? Encourage students to reflect on how design influences their environment and how they can use it to express identity, values, or purpose.
IMAGINE	Vector graphics can be very useful, for instance, in the design of a poster for a campaign about environmental awareness, or school events, to communicate messages effectively, and adapt the poster to different formats such as web banners, flyers, or large prints without losing quality. Organize students in small groups and let them brainstorm and sketch ideas for anything they wish to illustrate. It could be a logo that represents the group, a real or fictional community project, an icon set, a poster for an event or any cause they care about, a visual representation of an SDG, or even an artwork inspired by music, emotions, or nature. Encourage them to think freely, mix ideas from different sources, and express their personality or values. Let them learn about the principles of design and search for images that best represent each principle for inspiration. Introduce students to Inkscape, a free vector graphics software, and the software official and community tutorials. Before starting to put their ideas into practice, let them explore Inkscape freely to learn to use its various tools. There are great video tutorials online to guide them along the way.

CREATE	With their ideas in mind students can now begin creating their designs in Inkscape. Encourage them to explore and personalize their work, not just to replicate steps from tutorials but to try out tools and techniques that are essential in any design process. Inkscape tutorial for a logo Students should pay special attention to the following very common tools in design: ● **Color selection & gradients:** Use the Fill & Stroke panel to apply solid colors or subtle gradients. Encourage experimentation with color harmony to create mood and focus. ● **Text tool:** Add and customize text with font, size, spacing, and alignment. It's useful in logos, labels, or when combining images and messages. ● **Path operations:** Try combining shapes using operations like *Union*, *Difference*, *Intersection*, and *Exclusion*. These help build complex shapes from basic ones. ● **Path manipulations:** Convert objects to paths and edit their nodes to fine-tune curves and corners. ● **Alignment and distribution:** Use the Align & Distribute panel to center, space, and organize elements with precision, for balanced, professional designs. ● **Bitmap tracing:** Import an image (e.g., a hand-drawn sketch or photo) and use *Trace Bitmap* to convert it into vector shapes they can modify freely. Encourage students to explore these tools even if they don't use every feature, so they become familiar with them. Design is iterative process - trying, adjusting, and refining.

SHARE	Students participate in a classroom “gallery walk”: all digital designs are projected. For each design, classmates give feedback using explaining what they liked, the message they received and what can be improved. End with a class discussion on how design communicates meaning and how the tools supported their creative expression. Optionally, publish selected works in a school newsletter, blog, or social media page.