

Sounding the Alarm: School Solutions to Climate

Subjects and topics:

- Biology: Ecosystems and Climate Change Impacts
- Chemistry: Greenhouse Gases and chemical reactions.
- Physics: Heat Transfer, Energy, Waves.
- Mathematics: Data Analysis and Statistics.
- Information and Communication Technologies: Digital Literacy, Programming, Data Sonification, Multimedia.
- Arts: Sound Design and Storytelling.

Duration: 4 - 8 weeks

Grade level: 6th - 12th

Summary

School Solution to Climate challenges students to understand and address climate change through a multifaceted, interdisciplinary approach. Students will investigate the science behind the greenhouse effect, explore its impact on global and local climates, research evidence of climate change, raise community awareness, and propose actionable local solutions. The project encourages hands-on learning through experiments, data collection, and potentially even building electronic air quality stations. Transforming data into sound using sonification techniques will allow students to represent their findings creatively.

Students will also create a three-episode podcast to share their outputs with the community and local decision-makers.

1. FEEL

The Feel phase is the first step in design thinking, focusing on research and understanding a problem's impact on individuals and communities. It encourages empathy, curiosity, and critical thinking while prompting students to generate questions related to their curriculum, such as the importance of environmental protection. By exploring these questions, students engage with various STEAM concepts and conduct research through community surveys, expert visits, and online activities to deepen their understanding of the issue.

The topic of climate change is ubiquitous. We see it every day on the news. However, the causes and consequences are not always well understood, which leads to misconceptions and a lack of effective action.

While the fear of climate change impacts is nowadays widespread, such fear does not contribute to finding effective solutions. Students can play a vital role in climate change research and mitigation by developing and evaluating innovative solutions at the school community level.

The global problem

1 - The greenhouse effect is essential for life on Earth. As a starting point, ask your students to investigate why. After this, challenge them with the question “So why do greenhouse gas emissions can harm ecosystems?” There are plenty of resources online, such as [videos](#), podcasts, and interactive digital laboratories, (among others) that they can use to explore such questions.

2 - Engage your Students in a [greenhouse effect experiment](#) and record and discuss their results. Alternatively, students can use [online laboratories](#), however, be sure to guide them through a similar inquiry-based approach.

If the experiments have been carried out correctly, students should conclude that if the Earth system is comparable to that of the experiments, excess greenhouse gases in the atmosphere can lead to global warming.

The local problem

1 - Challenge your students to compile examples of evidence of [real](#) and [predicted impacts](#) of climate change, for example through literature research, the internet, or other resources.

2 - Students can be organised into groups, and each group is tasked with developing a hypothesis regarding local contributions to greenhouse gas emissions. If validated, these hypotheses could guide and impact the formulation of more environmentally friendly local policies and practices.

Example hypothesis: Traffic congestion and greenhouse gas emissions are highest during rush hour compared to other times of the day.

To **test the hypothesis**, students can, for instance, collect data on traffic volume and greenhouse gas emissions, or contact local transportation departments to request vehicle count records at different times of the day and in different places. They can also use online traffic monitoring tools such as Google Maps or Waze, which offer real-time data. To estimate emissions, students can apply standard emission factors for different types of vehicles or use online calculators for the carbon footprint associated with using vehicles with different fuel consumption. They can also consult local studies that have already measured emissions in the area and compare them with the results obtained. Additionally, they can monitor the air quality around the school using [dedicated sensors](#) that can be connected to the [micro:bit educational microcontroller](#), allowing them to program it to record CO₂ emissions throughout the day. Optionally, there are [online tutorials](#) to create electronic air quality stations, which can be a great way to learn new skills (such as electronics, soldering, programming, etc).

After completing these activities it is expected that students will have a solid understanding of the interconnectedness of global and local problems. The entire research process and description of the local problem should be documented.

RESULTS OF THE FEEL PHASE:

By the end of your implementation, you can add here results from this phase, including pictures, aha moments, quotes from students and other people involved, etc. This can inspire others to design projects as amazing as yours.

2. IMAGINE

Data sonification, when the protocol is clearly defined, enhances the intuitive understanding of results for large and diverse audiences. Hence it has great potential for raising awareness of the problem addressed, which is the first step in helping to devise solutions to the problem of local greenhouse gas emissions.

In this phase the class should **learn about sonification** and its potential. Students can be encouraged to explore several of the sonification methods provided by the [SoundScapes wiki](#), or others that they discover and develop. The aim at this stage is to acquire the techniques and skills to imagine and plan how the results obtained during the testing phase of their hypothesis can be sonified in a creative/artistic, appealing, and meaningful way. As a data source for exploring sonification techniques they can use online databases such as [Our World in Data](#) where they can find [data related to climate change](#) during the last century. This data can be sonified using data sonification *a posteriori* techniques. To learn how to work with a posteriori sonification you can follow the guidelines created by the SoundScapes team in [the projects' wiki](#).

The class should now **choose the target audience** of the sharing phase (e.g. the educational community, including tutors), justify the reason for their choice, and develop a concrete plan for how they will present the results of their studies and raise awareness of the problem.

The groups will be challenged to **imagine solutions to the problem** (including some that they can test during the implementation of the project), such as ways to connect individuals for shared rides, for example to school, reducing the number of cars on the road, walking to school, or other initiatives.

The class will devise a **plan for measuring the impact** of the proposed solutions when tested. Note that the impact of solutions has an environmental and a social dimension. In the environmental dimension, the impact can be measured, for example, by comparing emissions estimates before and after implementing the proposed solution. In the social dimension, the impact can be measured for instance through interviews and questionnaires to the community members involved. This data can also be sonified.

To share the results, the class should **plan a three-episode podcast**, using the following suggested program as a starting point (note: in this phase, students should only plan the

structure and methods used for the podcast. They will work on them and implement the plan in the SHARE phase):

Episode 1: (i) introduction to the students' project, justification for the choice of topic, and the use of sonification (explain what it is, its potential, and usefulness); (ii) the importance of the greenhouse effect for life on earth; (iii) the global problem of excess greenhouse gases and evidence from the experiments carried out; (iv) real and predicted impacts of climate change;

Episode 2: (i) the local problem of excess greenhouse gases in the atmosphere and evidence from the experiments carried out including justification for the choice of hypothesis, description of methods, results, and discussion; (ii) presentation of the sonified results and explanation of the [sonification protocol](#), that is, to which sound parameters and how the data was mapped.

Episode 3 : (i) a brief summary of the previous episodes (so that those who only listen to the last episode can get a sense of everything); (ii) recommendations for solutions to solve the local and global problems; (iii) the impact of the solutions tested; (iv) a summary of the pedagogical approach and its advantages.

This podcast program is a suggestion that can be adapted to the class needs and possibilities as well as to the content developed during the creation phase.

This phase ends with a detailed plan of what will be created.

RESULTS OF THE IMAGINE PHASE:

By the end of your implementation, you can add here results from this phase, including pictures, aha moments, quotes from students and other people involved, etc. This can inspire others to design projects as amazing as yours. You can include here all the ideas from your students. This might help others to solve the problem too.

3. CREATE

Each group will sonify the data obtained from their experiments and the whole class will contribute to the creation of the podcast. Although a concrete plan has been outlined, the creation phase is also a phase of exploration, discovery, and revision of procedures, so the plan will be open to change.

To complement and deepen the knowledge acquired, students can for example take part in **maker workshops** in school with their teachers, local Makerspaces/ Fablabs, or ask specialists in the fields of sonification and audio editing (like someone from the local radio) to offer a workshop in school. These workshops will be dedicated to sonification and the creation of podcasts (and other areas they feel necessary). If this is not possible, students can organize workshops by becoming “specialists” in these fields. To do this, they can form side groups in a [Jigsaw-like format](#) where each group will learn “everything” there is to learn about the topic it is responsible for (sonification, creating podcasts, and others). After which, the elements will return to their original group and teach others what they learned. This will maximise effectiveness and learning outcomes, and stimulate the development of autonomy, responsibility, collaboration, etc.

Regarding the problem and the solutions devised in the previous phase, each group will also **test one or more solutions** and **measure their impact**, whenever possible involving members of the community.

Practical example: Testing carpooling to school (sharing a car ride with others to reduce costs and environmental impact). It should make it possible to reduce the volume of emissions. It's simple to estimate the percentage and assess the impact on the people involved.

All activities should be documented in photo, video, and/or other formats for sharing and demonstrating the pedagogical and community impact.

RESULTS OF THE CREATE PHASE:

By the end of your implementation, you can add here results from this phase, including pictures, aha moments, quotes from students and other people involved, etc. This can inspire others to design projects as amazing as yours. You can include here pictures from their creations too.

4. SHARE

A **final event can be organised** at the school where the results of the activities will be presented and discussed. The entire educational community will be invited to this event, including the students' tutors. Members of the community involved and local decision-makers will also be invited. In particular, a representative of the local radio station will be invited and will be publicly presented with the podcasts and a proposal to broadcast the 3 episodes on the local radio.

The event will begin with a very **brief descriptive presentation of the studies** carried out, followed by the **presentation of the songs created** through sonification applied to the results obtained as a way of raising awareness of the issue. This will be followed by a **presentation of recommendations** for solving the problem of local greenhouse gas emissions into the atmosphere, as well as the impact of the solutions tested.

A series of workshops can also be held by the students on different sonification techniques to introduce the community to this pedagogical approach and its learning potential.

Alternatively, if it is not possible to organise a final event at school, a webinar can be organised online following a similar program.

All the records, results, documents, etc., of the activities carried out will be uploaded to the [SoundScapes online community](#) to inspire other teachers, students, or others, and to enable replication of what has been done.

RESULTS OF THE SHARE PHASE:

By the end of your implementation, you can add here results from this phase, including pictures, aha moments, quotes from students and other people involved, etc. This can inspire others to

design projects as amazing as yours. You can add here pictures of your students sharing their results and write down final considerations.