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Digital Eco-Leadership



# **IO2: Eco-Tech Learning Modules**

2025



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## CONTENTS

FOREWORD	5
Module 1: Introduction to Eco-Technology	6
Module 2: Digital Tools for Environmental Monitoring	20
Module 3: Sustainable Energy Technologies	65
Module 4: Smart Waste Management Solutions	76
Module 5: Green Transportation Innovations	91
Module 6: Eco-Entrepreneurship and Innovation	112
Pre and post assessment survey	122
Assessment key	123



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## FOREWORD

The **Digital Eco-Leadership - DigiEco** project underscores the paramount importance of arming educators with the requisite skills to adeptly wield digital tools in augmenting students' key competencies and digital literacy.

**IO2 „Eco-Tech Learning Modules”** aims at enhancing students' digital skills, ecoliteracy, and ability to generate solutions to environmental challenges and empowering teachers and trainers with the necessary tools and materials to guide students in acquiring digital skills and eco-literacy competencies

The 6 comprehensive learning modules of the Eco-Tech Learning Modules focused on eco-technology are designed to enhance students' digital skills and eco-literacy. They consist of lesson plans, activities, an inventory of digital tools used and an assessment survey.

### **Module 1: Introduction to Eco-Technology**

Students will explore real-world environmental challenges and brainstorm potential eco-technology solutions.

### **Module 2: Digital Tools for Environmental Monitoring**

Students will engage in field-based activities using digital tools, such as mobile apps, to collect environmental data.

### **Module 3: Sustainable Energy Technologies**

Students will investigate various sustainable energy technologies through learning scenarios.

### **Module 4: Smart Waste Management Solutions**

Students will analyze the challenges of waste management and explore smart technologies for optimizing waste collection and recycling processes.

### **Module 5: Green Transportation Innovations**

Students will examine the environmental impact of transportation systems and explore green transportation alternatives.

### **Module 6: Eco-Entrepreneurship and Innovation**

Students will create business plans, conduct market research, and pitch innovative solutions to address environmental challenges.



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## Module 1: Introduction to Eco-Technology

### Objectives:

- To introduce students to the concept of eco-technology.
- To help students understand real-world environmental challenges.
- To encourage creative thinking in proposing eco-friendly technological solutions.
- To build awareness of how technology can support sustainable development.

### Learning outcomes:

By the end of this module, students will be able to:

- Define eco-technology and explain its importance.
- Identify key environmental problems in their communities and globally.
- Propose basic eco-technology ideas to solve selected environmental issues.
- Use digital tools to research, visualize, and present eco-tech solutions.

### Methodology:

- Group discussions
- Brainstorming
- Interactive presentations
- Multimedia use (videos, visuals, online simulations)
- Eco-tech idea generation and presentation
- Formative assessment via digital tools

**Duration:** 3 hours

### References:

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## Lesson Plans

### Lesson 1: What is Eco-Technology?

#### Objective:

- To introduce students to the concept of eco-technology and explore real-world examples that solve environmental problems. Duration: 50-60 min.

#### Duration: 60 Minutes

#### Teaching materials for Warm-up Activity:

- Projector or smartboard
- 3–5 images showing environmental problems (e.g., polluted river, landfill, smoke from factories) [PICTURE 1](#), [PICTURE 2](#), [PICTURE 3](#)
- Sticky notes or small paper slips

#### Teaching materials for Lesson 1:

- Internet-connected devices (phones/tablets/laptops) or printed fact sheets
- "Eco-Tech Observation Sheet" (table format with columns: Name – Use – Problem Solved)
- Whiteboard or digital board
- Timer

## Description:

### WARM-UP ACTIVITY: What's the Problem? (10–15 minutes)

#### Purpose:

- To activate students' thinking about environmental issues that need solutions.

#### Teacher Preparation:

- Select and prepare 3–5 high-impact images related to environmental challenges.
- Display the images on the board or print them and place them around the classroom.

#### During the Lesson:

##### Step 1:

- The teacher projects or places the images in visible spots.
- Ask students to look at the images and think: silently

“What is happening here? What is the problem?”

##### Step 2:

- Give each student a sticky note or paper slip.
- Ask them to write one environmental problem they see in the images.

##### Step 3:

- Ask students to come forward and place their notes under each image.
- Read aloud a few of their responses.

##### Step 4:

- Ask:

“Which problem do you think is the most urgent?”

“Have you seen anything like this in your own town?”

#### Teacher Tip:

Keep the discussion short, visual, and interactive. Avoid overloading students with facts—this is an activation task.



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## MAIN ACTIVITY: Eco-Tech Around Us Scavenger Hunt

### Teacher Preparation:

- Prepare the "Eco-Tech Observation Sheet" (3 columns: Name of technology / Where is it used / What problem does it help solve).

Name of the Eco-Technology	Where or How It's Used	What Environmental Problem It Solves

- Test internet access and provide printed alternatives for offline use.
- Create a list of 3–5 sample eco-technologies (e.g., solar panels, green roofs) for students who may need help.

### During the Lesson:

#### Step 1:

- Explain that eco-technology refers to tools or systems designed to solve environmental problems using smart, nature-friendly solutions.
- Give a few quick examples (e.g., solar panels reduce dependence on fossil fuels).
- Emphasize: “Today we’ll become eco-tech detectives!”

#### Step 2:

- Divide students into small groups of 2–4.

## Step 3:

- Distribute the Eco-Tech Observation Sheets.
- Instruct students to find at least 3 real-world eco-technologies (can be local, national, or global).
- For each item, they must fill in:

What is the technology called?

Where is it used?

What environmental problem does it help solve?

## Step 4:

- Ask each group to share 1 of their examples.
- Write or display their answers on the board to build a class list.

## Step 5:

- Ask:

“Which eco-tech surprised you the most?”

“Which one do you think we could use in our school or city?”

## Teacher Tip:

Encourage creativity and critical thinking. It’s okay if students mention imperfect solutions—focus on the intention and impact.

## Recommendation for special needs students:

- Use simplified versions of the Observation Sheet with images.
- Allow voice recordings or verbal presentations.
- Pair students strategically for peer support.

## Inventory of digital tools used:

- Padlet or Jamboard: For collaborative sharing
- Canva: For groups who want to visualize their eco-tech idea
- Google Search or Ecosia: For eco-friendly browsing

## Assessment:

### Warm-Up Reflection Questions:

- What types of environmental problems did you notice in the images?
- Why do you think these problems are important to solve?
- Have you seen similar problems in your community?

### Scavenger Hunt Group Check-In:

- Can you explain how one of the technologies you found works?
- What environmental problem does it solve?
- Why do you think this technology is eco-friendly?
- Is it something that can be used in your school or city? Why or why not?



## Lesson 2: Create Your Eco-Friendly Community

### Objective:

- To empower students to apply their knowledge of environmental issues by designing an imaginary eco-friendly community using eco-technologies to solve real problems.

**Duration:** 60 Minutes

### Teaching materials:

- A3 paper or large poster sheets
- Markers, colored pencils, glue, scissors
- Printed icons or [clip-art of eco-tech solutions](#) (solar panels, recycling bins, wind turbines, bike paths, etc.)
- Optional: laptops/tablets for digital design
- Projector or board for a short warm-up presentation

### Description:

#### Step 1:

- Divide the class into small groups of 3–4 students.
- Assign group roles if needed (e.g., drawer, writer, presenter, researcher).

#### Step 2:

- Provide each group with:
- 1 sheet of A3 or poster paper (or access to [Canva/Google Slides](#) if digital)



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- Markers, colored pencils, scissors, glue
- Printed icons or clipart of eco-technologies (solar panels, green roofs, composting bins, bike lanes, wind turbines, etc.)



COMPOSTING

## Step 3:

- Tell students:

“You are designing your own eco-friendly town. Your town should be clean, green, and smart. Use eco-technologies to solve environmental problems like waste, **pollution**, **energy use**, and **transport**.”

- Minimum requirements:
- Include at least 4 eco-technologies
- Label each technology clearly
- For each one, answer:

What is it?

What problem does it solve?

Why is it useful in your town?

## Step 4:

- Students plan their eco-town layout.
- They can draw or place images of eco-technologies in different parts of the town (school, transport area, parks, houses, etc.).
- Encourage them to name their town and give zones (e.g., “Clean Energy Street,” “Recycling Park”).

## Step 5:

- Each group presents their eco-community for 1–2 minutes.
- They explain their choices and how the technologies make their town sustainable.

## Step 6:

- Allow time for peers to ask one question or give one compliment per group.

## Methodological guidelines:

- Introduce the task with examples of real eco-cities (e.g., Copenhagen, Masdar City, Freiburg).
- Offer guiding questions on the board:

“What will you do with the waste?”

“How will people travel?”

“How will energy be used?”

- Walk around during group work to support and give feedback.
- Focus on student collaboration, creativity, and clear application of eco-tech knowledge.

## Recommendation for special needs students:

- Allow students with writing difficulties to contribute through drawing or choosing pre-printed pictures.
- Let students use tablets with visual design apps instead of drawing.
- Offer simplified templates for groups that need more structure.

## Inventory of digital tools used:

- Canva, Google Slides, or Book Creator – for digital community posters
- Jamboard – for collaborative online sketching
- Kahoot or Quizizz – quick eco-tech review before or after the lesson

## Assessment:

- Group presentations (creativity, clarity, relevance of eco-tech choices)



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- Teacher observation of collaboration and participation
- Poster or digital project evaluated based on:
- Inclusion of at least 4 relevant eco-technologies
- Explanation of the problems addressed
- Visual creativity and communication



## Lesson 3: Eco-Invention Pitch Game – “Greenovators”

### Objective:

- To encourage students to invent and pitch a funny, fictional eco-technology product that could solve a real environmental problem—combining creativity, humor, and environmental thinking.

**Duration:** 60 Minutes

### Teaching materials:

- “Greenovators Pitch Cards” (idea prompt cards prepared by teacher)
- A4 or A3 paper
- Markers, colored pencils
- Optional: props, recycled materials, or basic craft supplies
- Timer or bell
- Projector or board for game rules

### Description:

Warm-up: “Eco-Words Charades” (10 minutes)

- Purpose: Build energy and get students thinking in eco-language through a fun, active guessing game.

Instructions:

- Write 6–8 eco-themed words on slips of paper (e.g., solar panel, compost, smog, wind turbine, recycling, green roof).

SOLAR PANEL	COMPOST	SMOG
WIND TURBINE	RECYCLING	GREEN ROOF

- Divide the class into two teams.
- One student from each team draws a card and acts out the word (no speaking!) while their team guesses.
- Keep score—each correct guess in 1 minute = 1 point.

Main Activity: “Greenovators – Eco-Invention Pitch Game” (40–45 minutes)

Purpose: Teams invent an imaginary eco-technology product and “pitch” it like in a startup competition.

Step 1:

- Divide the class into small groups (3–4 students).

Step 2:

- Each group draws 1–2 “Greenovators Pitch Cards” that give them:

## Greenovators Pitch Cards

<b>Card 1</b>	<b>Card 2</b>
<b>Problem: Too much plastic in the ocean</b> <b>Constraint: Must involve a banana</b>	<b>Problem: Air pollution in cities</b> <b>Constraint: Must be wearable</b>
<b>Card 3</b>	<b>Card 4</b>
<b>Problem: Water scarcity in dry areas</b> <b>Constraint: Must work underwater</b>	<b>Problem: Excessive food waste</b> <b>Constraint: Must be powered by movement</b>
<b>Card 5</b>	<b>Card 6</b>
<b>Problem: Deforestation</b> <b>Constraint: Must be used by animals</b>	<b>Problem: Energy overuse in homes</b> <b>Constraint: Must fly</b>
<b>Card 7</b>	<b>Card 8</b>
<b>Problem: Trash buildup in public spaces</b>	<b>Problem: Noise pollution from traffic</b>



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<b>Constraint: Must be edible</b>	<b>Constraint: Must fit in your pocket</b>
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- A real environmental problem (e.g., too much plastic waste, air pollution, water scarcity)
- A funny constraint or theme (e.g., must involve a banana, must be wearable, must be used by animals, etc.)

Example:

- Problem: Ocean plastic
- Constraint: Must be wearable

Students must invent something like:

A jacket that turns ocean plastic into sunglasses on the go!

Step 3:

- Students invent their eco-tech solution with a twist of humor and imagination.
- They must name it, sketch it, and describe:
  1. What it does
  2. How it works
  3. What problem it solves
  4. Why would people want to use it

## Eco-Invention Planning Sheet

Group Name: \_\_\_\_\_

Eco-Invention Name: \_\_\_\_\_

Draw your invention below:



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What does it do?

---

How does it work?

---

What environmental problem does it solve?

---

Why would people want to use it?

---

Step 4:

- Groups prepare a 1-minute pitch (can be serious or funny).
- Optional: Use props or drawings during the pitch.

Step 5:

- Each group presents its eco-invention to the class.
- The class votes on:
  - Funniest Idea
  - Most Creative
  - Most Realistic

### Methodological guidelines:

- Make sure the fun doesn't remove the learning: each product must still solve a real-world problem.
- Encourage all voices in the group (rotate roles: artist, speaker, idea generator).
- Use a timer to keep the energy high and prevent long preparation time.

### Recommendation for special needs students:

- Allow voice notes or visual-only presentations.
- Use simpler cards or assign peer buddies.



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- Offer the option to use pre-printed images to build their product pitch.

## Inventory of digital tools used:

- Canva or Google Drawings (for invention sketches)

## Assessment:

- Observation of creativity, collaboration, and problem-solving
- Participation in the pitch
- Completion of the invention sketch with explanation

## Greenovators Pitch Voting Slip

Your Name: \_\_\_\_\_

Vote for your favorite invention in each category below:

1. Funniest Idea:

Group Name or Invention: \_\_\_\_\_

2. Most Creative Idea:

Group Name or Invention: \_\_\_\_\_

3. Most Realistic Idea:

Group Name or Invention: \_\_\_\_\_

## Module 2: Digital Tools for Environmental Monitoring

### Lesson 1. Climate Change – Causes, Effects, and Responsibilities

Students will be able to critically analyze the global and local causes and effects of climate change, assess individual and collective responsibilities, and formulate evidence-based solutions for sustainable climate action

#### Objectives:

**By the end of the lesson, students will be able to:**

- Understand deeply the concept of climate change and its impact on the environment, biodiversity, and society.
- Identify and compare current and projected climate types for the year 2070 in their city using interactive data.
- Analyze the impact of global temperature rise on local and global species and ecosystems.
- Know concrete examples of individual and collective actions to reduce the impact of climate change.
- Develop collaboration, research, and argumentative expression skills in groups.

#### Expected Learning Outcomes

- The ability to interpret and compare climate data from interactive sources.
- The coherent synthesis of the effects of climate change on biodiversity.
- The formulation of well-reasoned conclusions about climate scenarios and the proposal of solutions.
- The critical use of official UN information to understand the scientific and political context of climate change.

#### Methodology

- Flipped Classroom
- Brainstorming
- Group Discussions



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- Investigation
- Problematisation

**Duration:** 60 minutes

## References

- Links to applications and websites:
  - <https://www.youtube.com/watch?v=EtW2rrLHs08>
  - <https://www.un.org/en/climatechange/what-is-climate-change>
  - [National Geographic Climate Change City App](#)
  - [Google Arts & Experiments – Climate Change Impact Filter](#)
  - [United Nations site on Climate Change Science](#)

## Teaching Materials

- Internet access and digital devices (laptops, tablets, smartphones).
- Digital worksheets (Google Docs) for recording observations and conclusions.
- Projector/digital whiteboard for instruction and demonstrations.

## Description

The teacher checks:

- each student's internet access on classroom or personal devices (laptop or phone);
- whether the recommended film has been watched – the optimal case; if not, students watch the film and note key concepts and questions;
- the work assignments and their completion can be done in a Word document, Google Docs, or on a sheet of paper provided by the teacher.

### Application 1

#### *Warm- ap and brainstorming*

10 minutes

Flipped Classroom – Preparatory Activity (before the lesson)

Before the lesson, students receive the assignment to watch a short introductory video about climate change (e.g., "Climate Change 101 with Bill Nye," National Geographic).

Reference: <https://www.youtube.com/watch?v=EtW2rrLHs08>

The students will note 3 relevant aspects and questions regarding the subject.

#### **Warm- ap and brainstorming**

- At the beginning of the lesson, the starting point is the students' questions from the Flipped Classroom phase.
- A plenary brainstorming session is organized, where students share what they have remembered and what questions they have.
- The teacher records the key concepts and open questions on the digital board for later clarification.

**Application 2**                      *Investigation using the National Geographic application*                      15  
minute

Students access the link

<https://www.nationalgeographic.com/magazine/graphics/see-how-your-citys-climate-might-change-by-2070-feature>

- Students individually access the application and enter their city.
- They collect information about the current climate and the projected climate for the year 2070.
- They calculate their age in 2070 and write a short prediction and reasoned conclusion about the impact on their city.
- A plenary discussion follows about possible scenarios, positive vs. negative, and what personal measures can be taken.

**Application 3** *Impact of rising temperatures on species and human-made objects*                      15  
minutes

Impact of rising temperatures on species and human-made objects.

Group Activity – Species Study through Google Arts & Experiments

Reference: <https://artsexperiments.withgoogle.com/impactfilter/>

- Students analyze on the digital platform what could happen to various species of plants and animals, as well as human-made objects (insects, birds, mammals, plants, Anthropocene, etc.) if the temperature rises by 3°C and then by 5°C.
- They record their conclusions in a shared Google Docs document and then quickly share their findings with the group.

Work Steps

1. Divide the students into groups of 4.
2. Each group chooses one section: insects, birds, reptiles & amphibians, mammals, plants, marine environments, Anthropocene.

3. Access the section and explore what happens if the temperature rises by 3°C, then by 5°C.
4. Note observations regarding species and environment.
5. The group formulates a conclusion on the impact of these changes and answers the question: Is it possible to stop warming at 2°C? What does this scenario mean?
6. Write conclusions in Google Docs and give a brief presentation to the class.

This activity utilizes Google Arts & Culture's "Climate Change Impact Filter" and similar interactive experiments to visually demonstrate how various species are affected by different temperature rise scenarios. It offers students an engaging way to explore and understand the potential loss of biodiversity as global temperatures increase.

## **Optional Application 4**      *Investigation of climate issues and actions on the UN website.*

Investigation of climate issues and actions on the UN website.  
(Investigation in pairs)

This activity involves students working in pairs to explore the official United Nations websites related to climate change.

Duration: 10 minutes for each section in pairs; Final discussion

### Materials

- Link to the UN website: <https://www.un.org/en/climatechange/science/climate-issues>
- Digital worksheets, Google Docs, sheets of paper for note-taking. Here is an integrated English version for the complete teaching segment you provided:

### Objective

Students will become familiar with the key aspects of climate change and the recommended scientific and social actions for addressing it. The activity aims to develop their critical thinking, research, and collaboration skills.

### Work Plan for Climate Issues Investigation on the UN Website

1. Forming pairs: Students are divided into pairs, with each pair assigned to access a specific section on the UN climate change website.
2. Section allocation: Each pair receives a different section from the following:
  - Energy
  - Ocean



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- Land
  - Health
  - Human Security
  - 1.5°C Global Warming Limit
  - Food
  - Biodiversity
  - Water
  - Greenwashing
  - Women’s role in climate action
  - Plastics management
3. Research and note-taking: Students access their assigned section, read the content, and note three relevant pieces of information along with their impact on climate action. Suggested focus points include the effects of climate change in the sector, recommended actions, and recent examples.

This structure encourages collaborative learning, critical questioning, and synthesis of complex topics in an interactive classroom setting

3. **Presentation in Plenary**  
After 10 minutes, each pair presents their section and conclusions in front of the class, using the shared Google Docs or digital worksheets to illustrate key points. Questions will be asked and there will be a discussion about the connections between the sections.
4. **Final Discussion** (5 minutes)  
The teacher synthesizes the main ideas and emphasizes the importance of coordinated action across all fields to combat climate change.

**At the end of the lesson**

<b>Application 5</b>	<i>Climate Change Time Capsule</i>	10 minutes
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**Interesting Method: “Climate Change Time Capsule”**

- Ask students to imagine they are living in the year 2070 looking back at decisions made in their lifetime.
- Each student writes a short message or prediction about how actions taken (or not taken) affected their city and the planet.
- Collect these messages in a “time capsule” (physical box or digital folder).

- This method personalizes the stakes and encourages forward-thinking responsibility.

## **Assessment**

Students are assessed formatively throughout the lesson based on the following criteria:

- **Active participation:** Engagement in brainstorming, group discussions, and interactive activities.
- **Collaboration:** Ability to work effectively in pairs or small groups during investigations and presentations.
- **Understanding of Concepts:** Accuracy and depth in interpreting climate data, identifying causes and effects, and explaining responsibilities during class activities and discussions.
- **Critical Thinking:** Quality of conclusions drawn in group work, including reasoning about climate scenarios and proposed solutions.
- **Use of Resources:** Effective use of digital tools, interactive applications, and official information sources (UN sites, apps) to support findings.
- **Communication Skills:** Clarity and coherence in oral presentations and written contributions on shared documents.

## **Recommendations for Students with Special Needs**

- Provide supplementary visual aids such as diagrams, infographics, and simple videos explaining noise pollution concepts.
- Assign a peer buddy or support staff to assist with group work and technical use of sound meter apps.
- Use simplified instructions with clear, short sentences and visuals.
- Allow extra time for practical activities and discussions.
- Give students defined roles within groups to enable focused contributions.
- For students with hearing impairments, provide written transcripts of videos and use captions.
- Ensure accessibility of all digital platforms and apps used.

## **Climate Change – Causes, Effects, and Responsibilities**

### **HANDOUT TEACHER**

## Application 1

### *Warm- up and brainstorming*

10 minutes

Flipped Classroom – Preparatory Activity (before the lesson)

Before the lesson, students receive the assignment to watch a short introductory video about climate change (e.g., "Climate Change 101 with Bill Nye," National Geographic, 4 min.).

Reference: <https://www.youtube.com/watch?v=EtW2rrLHs08>

The students will note 3 relevant aspects and questions regarding the subject.

The teacher records the **key concepts** and **open questions** on the digital board for later clarification

### **Key Concepts:**

1. Climate change is a real and serious issue caused primarily by human activities, mainly the burning of fossil fuels, which release greenhouse gases that trap heat in the Earth's atmosphere.
2. Global temperatures have risen significantly; the world is nearly 1°C warmer than in the late 19th century.
3. Consequences include rising sea levels, ocean acidification, extreme weather events, melting glaciers, and impacts on ecosystems and human health.
4. Climate change affects oceans, land, weather patterns, and biodiversity, threatening food security and water supply.
5. Individual actions such as recycling, conserving energy, eating less meat, using public transportation, and spreading awareness can contribute to solutions.

### Questions:

1. What human activities mainly cause climate change and how do they affect the Earth's atmosphere?
2. How much has the average global temperature increased since the late 19th century?
3. What are some of the main consequences of climate change for the environment and human health?

4. How does climate change impact oceans, land, weather patterns, biodiversity, food security, and water supply?
5. What individual actions can help reduce the effects of climate change?

### Open Questions:

- How can society rapidly reduce greenhouse gas emissions?
- What role do governments, businesses, and individuals have in combating climate change?
- How can we balance economic growth with environmental sustainability?
- What new technologies or policies could help mitigate or adapt to climate change?
- How can education and communication motivate global climate action?

Application 2 *Investigation using the National Geographic application* 15 minutes

Investigation using the National Geographic application (10 minutes)

<https://www.nationalgeographic.com/magazine/graphics/see-how-your-citys-climate-might-change-by-2070-feature>

- Students individually access the application and enter their city (Lisbon).
- Information about the current climate and the projected climate for the year 2070.

Analyzing the information:

- *is in a temperate climate zone, with hot, dry summers;*
- *Summer temperatures rise above 22°C for at least a month and stay above 10°C for at least four months. Usually, these regions are found along the western edges of continents.*
- *Climate conditions in Lisbon, Portugal- will likely change, but not enough to change its climate zone. About 189 km away, Badajoz, Spain will likely change from a temperate zone to an arid, hot steppe zone.*
- *Lisbon is at medium risk from climate change.*

*Its population is more susceptible to the impacts of such changes, and it will experience more exposure to physical changes. **Portugal is more able to adapt to climate change than other countries***

*Rangoon (Yangoon) Myanmar*

*Yangon is at extreme risk from climate change. Its population is more susceptible to the impacts of such changes, and it will experience more exposure to physical changes. **Myanmar is less able to adapt to climate change than other countries.***

*Izmir ( in the future like Karaisali)*

*Izmir is at high risk from climate change. Its population is more susceptible to the impacts of such changes, and it will experience more exposure to physical changes. **Turkey is less able to adapt to climate change than other countries.***

- They calculate their age in 2070 and write a short prediction and reasoned conclusion about the impact on their city. (about 60 years)
- A plenary discussion follows about possible scenarios, positive vs. negative, and what personal measures can be taken.

### **Application 3 Impact of rising temperatures on species and human-made objects**

15 minutes

Impact of rising temperatures on species and human-made objects

Group Activity – Species Study through Google Arts & Experiments

Reference: 4<https://artsexperiments.withgoogle.com/impactfilter/>

Work Steps

1. Divide the students into groups of 4.
2. Each group chooses one section: insects, birds, reptiles & amphibians, mammals, plants, marine environments, Anthropocene.
3. Access the section and explore what happens if the temperature rises by 3°C, then by 5°C.

4. Note observations regarding species and environment.
5. The group formulates a conclusion on the impact of these changes and answers the question: Is it possible to stop warming at 2°C? What does this scenario mean?
6. Write conclusions in Google Docs and give a brief presentation to the class.

This activity utilizes Google Arts & Culture's "Climate Change Impact Filter" and similar interactive experiments to visually demonstrate how various species are affected by different temperature rise scenarios. It offers students an engaging way to explore and understand the potential loss of biodiversity as global temperatures increase

Here are **key concepts** and **open questions** related to the **Climate Change Impact Filter** by Sey Min, which visually explores the effects of rising temperatures on species survival:

### Key Concepts:

- The experiment uses machine learning trained on thousands of Google Search images to cluster species affected by global warming.
- It shows what might be lost and what will remain as global temperatures rise, focusing on 62 different animal species across categories such as insects, birds, reptiles, mammals, plants, marine life, and the Anthropocene.
- The data is based on the UN's IPCC Reports, the International Union for Conservation of Nature (IUCN), and WWF.
- As temperatures increase (e.g., 1.2°C current, projected rise up to 5°C), many species face disappearance or drastic population declines.
- Visualizations help communicate possible futures and raise awareness of biodiversity loss driven by climate change.

### Open Questions:

- Which species are most vulnerable to specific temperature increases?
- What new forms of life or waste might dominate in a hotter world (the Anthropocene)?
- How can this visualization encourage more urgent climate action?

- What conservation efforts are critical to preventing the loss of biodiversity shown in the filter?
- How do these changes impact human societies and ecosystems?

## **Optional Application 4 *Investigation of climate issues and actions on the UN website***

(Investigation in pairs)

This activity involves students working in pairs to explore the official United Nations websites related to climate change.

### **Duration**

10 minutes for each section in pairs. 5 minutes for Final discussion

- Link to the UN website: <https://www.un.org/en/climatechange/science/climate-issues>

### **Work Plan for Climate Issues Investigation on the UN Website**

1. Forming pairs: Students are divided into pairs, with each pair assigned to access a specific section on the UN climate change website.

Section allocation: Each pair receives a different section from the following: energy, ocean, land, health, human security, 1.5°C Global Warming Limit, food, biodiversity, water, greenwashing, women's role in climate action, plastic management.

Each pair must note **3 interesting aspects**.

Here are **three relevant pieces** of information **for each section** from the UN climate issues site, summarizing key points related to climate change impacts and responses.

#### Energy

- Energy production is a major source of greenhouse gas emissions, primarily from burning fossil fuels.
- Transitioning to renewable energy sources (solar, wind, hydro) is critical to reducing emissions.
- Energy efficiency and clean technologies are vital for achieving climate goals.

#### Ocean

- Oceans absorb over 90% of the excess heat from global warming, leading to warming and acidification.
- Ocean warming disrupts marine ecosystems and reduces fish stocks.
- Sea-level rise from melting ice threatens coastal communities worldwide.

## Land

- Land ecosystems are affected by changing temperature and precipitation patterns.
- Deforestation accelerates climate change by releasing stored carbon.
- Sustainable land management and reforestation help mitigate climate impacts.

## Health

- Climate change increases the frequency of heatwaves, affecting vulnerable populations.
- Changes in climate contribute to spread of vector-borne diseases such as malaria.
- Food and water insecurity caused by climate change pose health risks.

## Human Security

- Climate change exacerbates conflicts over resources like water and arable land.
- Displacement due to extreme weather and sea-level rise poses humanitarian challenges.
- Strengthening resilience and adaptation is necessary to protect human security.

## 1.5°C Global Warming Limit

- Limiting warming to 1.5°C is crucial to avoid severe climate impacts.
- Current national commitments are insufficient, and more ambitious actions are needed.
- Every fraction of a degree beyond 1.5°C increases risks of extreme weather and ecosystem disruption.

## Food

- Climate change threatens global food security through droughts, floods, and temperature extremes.
- Crop yields and nutrition levels decline under increased temperatures.
- Sustainable agriculture and reduced food waste are part of the solution.

## Biodiversity

- Over 1 million species face extinction due to climate change and habitat loss.
- Biodiversity loss undermines ecosystem services vital to humans.
- Protecting and restoring habitats are essential conservation strategies.

## Water

- Climate change alters rainfall patterns, causing floods and droughts.
- Glacial melt threatens freshwater availability for millions.
- Integrated water resource management helps build resilience.

## Greenwashing

- Some companies use misleading claims about environmental practices to appear sustainable.
- Greenwashing undermines genuine climate action.
- Transparency and accountability are key to combating greenwashing.

## Women's Role in Climate Action

- Women are disproportionately affected by climate change but play vital roles in adaptation and mitigation.
- Empowering women through education and leadership strengthens community resilience.
- Gender-responsive climate policies are necessary for equitable solutions.

## Plastics Management

- Plastic pollution contributes to environmental degradation and greenhouse gas emissions.

- Reducing plastic use and improving recycling are important climate actions.
- International cooperation is needed to manage plastic waste effectively.

## At the end of the lesson

### Application 5

### *Climate Change Time Capsule*

10 minutes

### Interesting Method: “Climate Change Time Capsule”

- Ask students to imagine they are living in the year 2070 looking back at decisions made in their lifetime.
- Each student writes a short message or prediction about how actions taken (or not taken) affected their city and the planet.
- Collect these messages in a “time capsule” (physical box or digital folder).
- This method personalizes the stakes and encourages forward-thinking responsibility.

## Assessment

Students are assessed formatively throughout the lesson based on the following criteria:

- Active participation: Engagement in brainstorming, group discussions, and interactive activities.
- Collaboration: Ability to work effectively in pairs or small groups during investigations and presentations.
- Understanding of concepts: Accuracy and depth in interpreting climate data, identifying causes and effects, and explaining responsibilities during class activities and discussions.
- Critical thinking: Quality of conclusions drawn in group work, including reasoning about climate scenarios and proposed solutions.
- Use of resources: Effective use of digital tools, interactive applications, and official information sources (UN sites, apps) to support findings.

Communication Skills: Clarity and coherence in oral presentations and written contributions on shared documents

## Definitions and Key Concepts about Climate Change

Here is a concise list of important definitions and key concepts related to climate change, based on Britannica and UN sources:

- **Climate Change:** Long-term changes in average weather conditions (temperature, precipitation, wind) globally or regionally, caused naturally or by human activities increasing greenhouse gases.
- **Global Warming:** A steady rise in Earth's average atmospheric and ocean temperatures, primarily due to human activities like burning fossil fuels.
- **Greenhouse Gases:** Atmospheric gases such as carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), and nitrous oxide (N<sub>2</sub>O) that trap solar heat and contribute to global warming.
- **Carbon Footprint:** The total amount of CO<sub>2</sub> (or equivalent) emitted directly or indirectly by a person, organization, product, or event.
- **Carbon Neutrality:** Balancing the amount of greenhouse gases emitted with those absorbed or offset by methods like tree planting.
- **Climate Change Adaptation:** Actions by people and ecosystems to adjust behavior or conditions to cope with climate change effects, e.g., building dikes or planting urban trees for cooling.
- **Climate Change Mitigation:** Measures to reduce greenhouse gas emissions and limit global warming, such as using renewable energy and improving energy efficiency.
- **Biodiversity:** The total variety of life on Earth, including all plant, animal, fungal, and microorganism species and their ecosystems, threatened by climate change.
- **Direct and Indirect Effects of Climate Change:** Examples of direct effects include glacier melting, sea-level rise, and extreme weather; indirect effects include species migration, economic damages, and public health problems.

- **Sustainability:** Using natural resources in a way that does not compromise future generations' ability to meet their needs.

These foundational concepts establish the scientific basis for understanding climate change and guide related educational activities.

## **Lesson 2. LOUD AND CLEAR: THE SOUND EMERGENCY WE CAN'T IGNORE NOISE POLLUTION**

### **General Objective**

Understanding the concept of noise pollution: causes, effects, and protective measures.

### **Specific Objectives**

By the end of the lesson, students will be able to:

1. Define noise pollution, noise, and sound intensity (dB).
2. Use a digital sound meter to measure noise levels.
3. Identify the main sources of noise pollution.
4. Understand the effects of noise pollution on health and the environment.
5. Propose solutions to reduce noise pollution.

### **Learning Outcomes**

Students will know how to:

- Define noise pollution and noise.
- Use a digital sound meter and interpret its readings.
- Identify noise sources in their surroundings.
- Explain the effects of noise on health and the environment.
- Propose protective and noise reduction measures.

### **Methodology**

- Group and individual work
- Educational game (Wordwall)
- Brainstorming and debate
- Use of multimedia: videos, Google Slides, official websites
- Practical activity with a digital sound meter
- Role play (optional)
- Test - self-assessment

**Duration** 60 minutes

## Teaching Materials and Resources

- Computer, Tablet, smartphone with internet access;
- Digital sound meter or app (Sound Meter or <https://webbrowsertools.com/sound-meter/>);
- YouTube videos about noise and nature;
- Wordwall exercise on noise levels and sound intensity in dB  
[https://wordwall.net/resource/96473638/nivelul-de-zgomot-intensitatea-sunetelor-%c3%aen-db](https://wordwall.net/resource/96473638/nivelul-de-zgomot-intensitatea-sunetelor-%c3%aen-db;);
- Google Docs/Slides for notes and practical activities;
- Google Maps (<https://www.google.com/maps>);
- Informative websites (Britannica Encyclopedia, EEA, WHO)

## References

- Sound meter  
<https://webbrowsertools.com/sound-meter/>
- Wordwall exercise on noise levels in dB to introduce the measurement unit.  
<https://wordwall.net/resource/96473638/nivelul-de-zgomot-intensitatea-sunetelor-%c3%aen-db>
- Define pollution



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<https://www.britannica.com/science/noise-pollution>

- Noise pollution. The Noise Observation & Information Service for Europe

<https://noise.eea.europa.eu/>

- Impact of noise pollution

[https://cdn.who.int/media/docs/default-source/documents/health-topics/deafness-and-hearing-](https://cdn.who.int/media/docs/default-source/documents/health-topics/deafness-and-hearing-loss/j0041_mls_whd_media_toolkit_singles_web_v12.pdf?sfvrsn=fe410198_10&download=true)

[loss/j0041\\_mls\\_whd\\_media\\_toolkit\\_singles\\_web\\_v12.pdf?sfvrsn=fe410198\\_10&download=true](https://cdn.who.int/media/docs/default-source/documents/health-topics/deafness-and-hearing-loss/j0041_mls_whd_media_toolkit_singles_web_v12.pdf?sfvrsn=fe410198_10&download=true)

<https://www.eea.europa.eu/en/analysis/publications/environmental-noise-in-europe-2025/terminology-and-examples-of-types-of-noise-management-and-mitigation-measures>

- Biological indirect pathways through which environmental noise impacts health (infographic)

<https://www.eea.europa.eu/en/analysis/publications/environmental-noise-in-europe-2025/biological-indirect-pathways-through-which-environmental-noise-impacts-health>

- Tips for Safe Listening

[https://cdn.who.int/media/docs/default-source/documents/health-topics/deafness-and-hearing-loss/tips-for-mls-en.pdf?sfvrsn=819242a0\\_5](https://cdn.who.int/media/docs/default-source/documents/health-topics/deafness-and-hearing-loss/tips-for-mls-en.pdf?sfvrsn=819242a0_5)

- Soundscape design

<https://climate.sustainability-directory.com/term/urban-soundscape-design/>  
<https://prism.sustainability-directory.com/term/urban-soundscape-restoration/>

## Lesson Development

### The teacher announces how the lesson will proceed

- we will work on this topic in pairs;
- we have access to the internet via laptops or smartphones;
- open a Word document, Google Docs, phone notes; alternatively: a sheet of paper. Write down your name and the topic. We can't ignore noise pollution. You will note down the completed applications one by one. Short and clear.
- at the end of the lesson, you will upload your answers to the classroom or wherever your teacher directs you. Alternatively, the sheets will be handed in to the teacher.

## Warm-up Activity (Application 1a, 1b)

10 minutes

### Application 1 a. *Measuring sources of noise*

- Students access a noise pollution tool (free) <https://webbrowsertools.com/sound-meter/> and performs the 4 measurements and record the values recorded.
- To introduce students to the topic, ask them to:
  - clap their hands, talk to their neighbor;
  - beat the rhythm of Queen's famous song, We Will Rock You;
  - and finally, whisper their conclusions about this experience to each other.
- discuss whether these sounds are pleasant or noisy.

### Application 1 b. *Match the source of noise/sound with dB values.*

Apply the Wordwall exercise on noise levels in dB to introduce the measurement unit.

#### Match the source of noise/sound with dB values.

<https://wordwall.net/resource/96473638>

### Application 2 *Brief Teaching – Noise Pollution: Definitions and Concepts -10 minutes*

- Define noise pollution, noise, and sound intensity (dB).
- Important values: 0 dB (silence), 80 dB (risk of harm), 105 dB will have permanent hearing loss to some extent, 140 dB (immediate pain).
- Noise pollution impacts humans and wildlife.
  - Reference: Britannica

<https://www.britannica.com/science/noise-pollution>

### Application 3 *Sources of Noise Pollution*

5 minutes

Students access the links below, read through the information, and briefly answer the questions.

- a. What are the most significant sources of noise pollution identified?



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- Mobile sources: road, rail, air traffic, industry
  - Fixed sources: factories, construction sites, household appliances, commercial spaces
  - Example urban traffic video: <https://pixabay.com/ro/videos/trafic-ora%C8%99-peisaj-urban-urban-88921/>
- b.** Students access data for Portugal and their country of origin. Do they identify any similarities? Are there any differences? Write down an example.
- Reference: <https://noise.eea.europa.eu/>  
<https://www.eea.europa.eu/themes/human/noise/sub-sections/noise-fact-sheets>
- c.** Class discussion: What sources exist in your environment?

## Application 4

### *Impact of Noise Pollution on Humans*

15 minutes

- a.** Students access the *Biological indirect pathways through which environmental noise impacts health (infographic)*.

➤ Reference:

<https://www.eea.europa.eu/en/analysis/publications/environmental-noise-in-europe-2025/biological-indirect-pathways-through-which-environmental-noise-impacts-health>

### **Students analyze the infographic and answer questions.**

1. What are the consequences of noise pollution?
  2. What are the indirect biological ways in which environmental noise affects health?
  3. Identify four effects on the body's systems and processes
- b.** Students access the **WHO (World Health Organization) link**, a document created for World Hearing Day (March 3). Browse through the following pages.
- *Hearing loss: Key facts* (pg.2, 3);
  - *Impact of hearing loss* (pg.4, 5);
  - *How can hearing be protected?* (pg.9, 10).

*For each section, students note 2-3 aspects that caught your attention. Formulate a conclusion. Does noise pollution have an impact on the environment and people? What are the values that should not be exceeded? How can we avoid hearing loss?*

- Effects on hearing, sleep, stress, cognitive problems, cardiovascular diseases.
- WHO material – “World Hearing Day”:

➤ Reference:

[https://cdn.who.int/media/docs/default-source/documents/health-topics/deafness-and-hearing-loss/j0041\\_mls\\_whd\\_media\\_toolkit\\_singles\\_web\\_v12.pdf?sfvrsn=fe410198\\_10&download=true](https://cdn.who.int/media/docs/default-source/documents/health-topics/deafness-and-hearing-loss/j0041_mls_whd_media_toolkit_singles_web_v12.pdf?sfvrsn=fe410198_10&download=true)

### c. Tips for Safe Listening

Access the link

[https://cdn.who.int/media/docs/default-source/documents/health-topics/deafness-and-hearing-loss/tips-for-mls-en.pdf?sfvrsn=819242a0\\_5](https://cdn.who.int/media/docs/default-source/documents/health-topics/deafness-and-hearing-loss/tips-for-mls-en.pdf?sfvrsn=819242a0_5)

Keep in mind how can hearing be protected.

### Optional Application 5      *Soundscape Design*

*only to see about 10  
minutes*

„Urban **Soundscape Design** is fundamentally about intentionally shaping the urban sonic environment for human benefit.” <https://climate.sustainability-directory.com/term/urban-soundscape-design/>

With a proposed framework for designing soundscape in urban open public spaces, considering four key components, including characteristics of each sound source, acoustic effects of the space, social/demographic aspect of the users, and other physical conditions, design potentials are demonstrated

Use IA (Gemini, ChatGPT, Perplexity.ai, claude.ai, copilot, deepseek) for designing the soundscape (**Soundscape Design**). Respond to the following questions and note suggested links/articles.

- a. The meaning of the soundscape and how it can be intentionally controlled or created in cities.
- b. Design strategies to introduce positive natural sounds in cities.
- c. Find examples of urban projects or interventions that positively change acoustic quality.

Ex. <https://prism.sustainability-directory.com/term/urban-soundscape-restoration/>

Note key components of soundscape (acoustic environment, human perception, context)



- Assign a peer buddy or support staff to assist with group work and technical use of sound meter apps.
- Use simplified instructions with clear, short sentences and visuals.
- Allow extra time for practical activities and discussions.
- Give students defined roles within groups to enable focused contributions.
- For students with hearing impairments, provide written transcripts of videos and use captions.
- Ensure accessibility of all digital platforms and apps used.

## Noise Pollution — Worksheets and Topics for In-Depth Research

### Optional Student Worksheets

#### Worksheet 1: Definitions and Basic Concepts

1. Define in your own words the following terms:
  - Noise pollution
  - Noise
  - Decibel (dB)
2. What is the range of sound intensity that the human ear can perceive?
3. Name at least three mobile sources and three fixed sources of noise pollution.

#### Worksheet 2: Analyzing Noise Pollution in Your Local Environment

1. Using Google Maps, identify an area in your city that you think is polluted by noise. Specify the sources of noise in that area.
2. Use a digital sound meter to measure noise levels in three different places at school/yard/home. Record the values and the noise sources. Take screenshots showing your location on the map and the value on the sound meter.

3. Interpret the values obtained: which exceed the recommended threshold of 80 dB? What are the associated risks?
4. Propose at least two concrete local measures to reduce noise in these areas and explain your choices.

### Worksheet 3: Case Study and Measures

1. Access the EEA document with noise control measures (link below). Select five measures you think can be effectively applied in your city.
2. Explain how each measure can help reduce noise pollution.
3. What obstacles might exist in implementing these measures? How could they be overcome?

Link to measures document:

<https://www.eea.europa.eu/en/analysis/publications/environmental-noise-in-europe-2025/terminology-and-examples-of-types-of-noise-management-and-mitigation-measures>

### Topics for In-Depth Research

#### Topic 1: "Active Noise Cancellation"

- Research the technological principles by which headphones with active noise cancellation effectively reduce noise.
- Present current and potential applications in transport, smart homes, or public spaces.
- Reflection: How could these technologies contribute to quieter cities in the future?

#### Topic 2: "Smart Cities and Noise Monitoring"

- Document how sensor networks monitor noise in real time.
- Identify benefits and challenges of implementing such a system in your city.

- Give examples of how collected data could change public policies for a healthier environment.

### Topic 3: "Impact of Electric Vehicles on Urban Noise Levels"

- Compare noise levels generated by conventional vehicles versus electric vehicles.
- Analyze effects of the shift toward electric transport on noise pollution.
- Present any limitations or other urban noise sources that remain problematic.

### Useful Resources for Research

- World Hearing Day materials (WHO):  
<https://www.who.int/campaigns/world-hearing-day/2022/information-materials#cms>
- EEA Environmental Noise in Europe 2025 report:  
<https://www.eea.europa.eu/en/analysis/publications/environmental-noise-in-europe-2025>
- Online sound meters and apps for practical measurements.

### Guide for Assessing Worksheets — Noise Pollution

#### 1. Accuracy and Clarity of Answers (40%)

- Correct, complete, and coherently explained definitions (noise pollution, noise, decibel).
- Correct identification of pollution sources and effects on health and environment.
- Interpretation of measurement values in the context of permitted limits.
- Use of scientific language appropriate to students' level.

#### 2. Practical Application and Analysis (30%)

- Relevance and accuracy of measurements using digital sound meter or app.
- Identification of noise-polluted locations and sources supported with arguments.
- Feasible and well-argued proposals for noise reduction.



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- Ability to connect theory with practical observations or case studies.

### 3. Structure and Organization (15%)

- Clear, orderly presentation of answers.
- Correct use of indicated sources and links.
- Compliance with formatting requirements (Google Docs, clear pages, titles).

### 4. Creativity and Depth (15%)

- Original proposals for local measures or new technologies.
- Ability to use research topics to extend knowledge.
- Participation in debates or formulation of an informed personal viewpoint.

### Suggestions for Teacher Feedback

- If answers are correct but incomplete, encourage students to elaborate with further questions.
- For misunderstandings, provide additional explanations and simple examples.
- Value efforts that link theory with practice — measurements and concrete proposals.
- Highlight and appreciate creativity and solid argumentation in proposals.
- Recommend supplementary resources for students interested in deeper study.

### Noise Pollution Quiz

#### Multiple Choice Test for Students

**Instructions:** Choose the best answer for each question. Select only ONE option per question.

#### 1. What is noise pollution?

- a) Any sound that is louder than 50 decibels.
- b) Unwanted or harmful sounds that disrupt the environment and human activities.

- c) Only sounds produced by industrial machinery.
- d) Natural sounds like thunder and wind.

**2. At what decibel level does sound begin to pose a risk of hearing damage?**

- a) 60 dB
- b) 70 dB
- c) 80 dB
- d) 90 dB

**3. Which of the following represents the decibel level that causes immediate pain or even deafness to the human ear?**

- a) 100 dB
- b) 120 dB
- c) 140 dB
- d) 160 dB

**4. Which of these is considered a MOBILE source of noise pollution?**

- a) Construction sites
- b) Factory machinery
- c) Air conditioning units
- d) Road traffic

**5. What does 0 dB represent on the decibel scale?**

- a) Complete silence (threshold of hearing)
- b) Normal conversation level
- c) The loudest sound humans can hear
- d) The sound of a whisper

**6. Which health effect is NOT typically associated with prolonged exposure to noise pollution?**

- a) Hearing loss
- b) Sleep disturbances
- c) Improved memory function
- d) Cardiovascular diseases

**7. According to the lesson, which organization provides data on noise pollution's effects at the European level?**

- a) WHO (World Health Organization)
- b) EEA (European Environment Agency)
- c) UNESCO
- d) UNICEF

**8. What type of noise source would a household appliance be classified as?**

- a) Mobile source
- b) Fixed source
- c) Natural source
- d) Temporary source

**9. Which of the following is an effective measure to reduce noise pollution in urban areas?**

- a) Increasing traffic speed limits
- b) Building more airports near residential areas
- c) Creating green zones and sound barriers
- d) Encouraging the use of louder car horns

**10. What is the main purpose of using a digital sound meter in the practical activity described in the lesson?**

- a) To create more noise in the environment
- b) To measure and record actual noise levels in different locations
- c) To play music at specific volumes
- d) To communicate with other students during group work

**Answer Key:**

- 1. b) Unwanted or harmful sounds that disrupt the environment and human activities
- 2. c) 80 dB
- 3. c) 140 dB
- 4. d) Road traffic
- 5. a) Complete silence (threshold of hearing)
- 6. c) Improved memory function
- 7. b) EEA (European Environment Agency)
- 8. b) Fixed source
- 9. c) Creating green zones and sound barriers
- 10. b) To measure and record actual noise levels in different locations



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## LOUD AND CLEAR: THE SOUND EMERGENCY

### WE CAN'T IGNORE NOISE POLLUTION

#### Handout / worksheet / teacher

- We will work on this topic in pairs. Open a Word document/Google Docs/phone notes/ alternatively: a sheet of paper.
- Write down your name and the topic. We can't ignore noise pollution. You will note down the completed applications one by one. Short and clear.
- At the end of the lesson, you will upload your answers to the classroom or wherever your teacher directs you. Alternatively, the sheets will be handed in to the teacher.

#### Warm-up Activity

**Application 1a**      *Measuring sources of noise*      10  
*minutes*

Students access a noise pollution tool (free) <https://webbrowsertools.com/sound-meter/> and performs the 4 measurements

Measurement 1 - over 70 dB

Measurement 2 – over 60 dB

Measurement 3 – over 80 dB

Measurement 4 – over 40 dB

**Application 1b**      *Match the source of noise/sound with dB values*      5  
*minutes*

A wordwall exercise where students can match the source of noise/sound with dB values.

<https://wordwall.net/resource/96473638/nivelul-de-zgomot-intensitatea-sunetelor-%c3%aen-db>



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My Answers ✓ 10

60 dB ✓		70 dB ✓	
130 dB ✓		30 dB ✓	
140 dB ✓		85 dB ✓	
90 dB ✓		105 dB ✓	
10 dB ✓		120 dB ✓	

Correct Answers Back

Nivelul de zgomot (intensitatea sunetelor în dB)  
by Geografiemamit

Edit Content Print Set Assignment More

## Application 2 *Brief Teaching – Noise Pollution: Definitions and Concepts* 10 minutes

Access the link <https://www.britannica.com/science/noise-pollution>

Students review the information and briefly answer questions.

### a. What is noise pollution?

- **noise pollution**, unwanted or excessive sound that can have deleterious effects on human health, wildlife, and environmental quality;

### b. What is the unit of measurement for sound intensity?

- is measured in logarithmic units called decibels (dB)
- because of the logarithmic nature of the decibel scale, an increase of 10 dB represents a 10-fold increase in sound intensity, an increase of 20 dB represents a 100-fold increase in intensity.

### c. How many decibels can the human ear detect? At how many decibels can hearing loss occur?

- the normal human ear can detect sounds that range between 0 dB (hearing threshold) and about 140 dB, with sounds between 120dB and 140 dB causing pain (pain threshold).
- at over 120 dB, because sounds at this level can cause pain and auditory damage.
- Hearing loss can begin at noise exposure levels of 85 decibels (dB) or higher, especially if the exposure lasts more than eight hours. Sounds at or below 70 dB are generally safe for hearing, but prolonged exposure above 85 dB can cause gradual hearing loss. Louder noises cause damage more quickly; for example, exposure to 100 dB sounds, like power tools, can damage hearing in a shorter time, while sounds above 120 dB can cause immediate harm. The threshold of 85 dB is the recommended limit to minimize hearing loss risk

### d. Effects on humans and wildlife.

- for humans: temporary or permanent hearing loss may occur
- for wildlife: noise pollution can interfere with an animal's ability to attract a mate, communicate, navigate, find food, or avoid predators ([echolocation](#), such as certain [whales](#) and [dolphins](#)).

### Application 3 *Sources of Noise Pollution*

5 minutes

#### Access the link

- <https://noise.eea.europa.eu/>

Students review the information and briefly answer questions.

#### a. What are the most significant sources of noise pollution identified?

- Mobile sources: road, rail, air traffic
- Fixed sources: factories, construction sites, household appliances, commercial spaces

#### b. Access the link

- <https://www.eea.europa.eu/themes/human/noise/sub-sections/noise-fact-sheets>
- Students access data for Portugal and their country of origin. Do they identify any similarities? Are there any differences? Write down an example.

e.g.: Similarity: the biggest polluters, road transport

e.g.: Difference between Portugal and Romania: In Portugal, pollution from road transport increased steadily between 2012 and 2017, while in Romania it remained consistently high.

#### c. Class discussion: What sources of noise pollution exist in your environment?

### Application 4- Impact of Noise Pollution on Humans

15 - minutes

#### a. Access the link of European Environment Agency

<https://www.eea.europa.eu/en/analysis/publications/environmental-noise-in-europe-2025/biological-indirect-pathways-through-which-environmental-noise-impacts-health>

*Student analyze the infographic: **Biological indirect pathways through which environmental noise impacts health** and and answers questions.*

#### 1. What are the consequences of noise pollution?

- Affects biological processes by triggering physiological stress responses

#### 2. What are the indirect biological ways in which environmental noise affects health?



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- Individual vulnerability;
- Sleep disruption;
- Stress;
- Circadian rhythm disruption.

3. Identify four effects on the body's systems and processes:

- Accelerated ageing;
- Cerebrovascular dysfunction;
- Circadian dysregulation;
- Metabolic alterations;
- Neuroinflammation.

**b.** Access the **World Health Organization** link:

[https://cdn.who.int/media/docs/default-source/documents/health-topics/deafness-and-hearing-loss/j0041\\_mls\\_whd\\_media\\_toolkit\\_singles\\_web\\_v12.pdf?sfvrsn=fe410198\\_10&download=true](https://cdn.who.int/media/docs/default-source/documents/health-topics/deafness-and-hearing-loss/j0041_mls_whd_media_toolkit_singles_web_v12.pdf?sfvrsn=fe410198_10&download=true)

By accessing the link, students can identify this information. They can select two or three pieces of information for each section.

**Hearing loss: key facts** (pg.2, 3)

- **5 % of the world population (430 mil.) has hearing loss that affects their quality of life;**
- Hearing loss has far-reaching social and economic repercussions (980 billion dollars);
- Common causes of hearing loss include (students may note 2-3 causes): genetic conditions, complications at birth, certain infectious diseases, chronic ear infections, exposure to loud sounds or noise, use of certain medicines, and age-related changes;
- noise-induced hearing loss: „can hear the sounds, but not understand what is being said”;
- Many causes of hearing loss, including noise-induced hearing loss, are avoidable.
- Loud sounds damage ears and can lead to persistent **tinnitus** and hearing loss. (*“Tinnitus” refers to a persistent ringing or buzzing sensation in the ear, with no external sound stimulus.*)

**Impact of hearing loss** (pg.4,5)

There is real risk of irreversible noise-induced hearing loss due to recreational exposure, especially in adolescents and young adults:

- About half of young people aged 12 to 35—around 1.1 billion—are at risk of losing their hearing because they listen to music too loudly on phones or go to loud concerts and clubs. Listening to loud sounds for too long can hurt your ears and cause hearing problems later;
- Around 40% of 12–35-year-olds are exposed to potentially damaging sound levels at clubs and bars
- Promoting and practicing safe listening is one of the simplest ways to prevent the occurrence of hearing loss that is caused by recreational exposure to loud sounds.
- Impact:
  - **Communication and speech**, this can have a profound effect on language development in children;
  - **Cognition**, language deprivation can lead to delayed cognitive development in children;
  - **Education and employment**, in developing countries, children with hearing loss and deafness often do not receive schooling. Adults with hearing loss also have a much higher unemployment rate;
  - **Social and emotional**, although hearing loss contributes to social isolation and loneliness at all ages, these are experienced more specifically in people of older ages.
  - **Economic**, 980 billion dollars: this includes costs for the health sector (which exclude costs of hearing care such as hearing screening, hearing aids, implants or rehabilitation); costs of educational support; and costs resulting from loss of productivity.

## What is unsafe listening? (pg.7)

Unsafe listening refers to the common practices of listening to music or other audio content at loud levels or for prolonged time periods. Sensory cells in the ears can start to become damaged by prolonged exposure to loud sounds. Listening to sounds at 80 dB for 40 hours a week is the limit of safe listening.

## How can hearing be protected? (pg.9)

- **Keeping the volume down**- Listening to personal audio systems at a volume level below 60% of maximum
- **Limiting time spent engaged in noisy activities**- When in nightclubs, discotheques, bars, sporting events and other noisy environments, taking short listening breaks away from loud noise reduces the overall duration of noise exposure.

- **Monitoring listening levels** - Many devices, such as smartphone apps or listening software, use built-in safety features, such as volume limiting and sound level monitoring (keeping track

of the sound consumed and alerting the listener if the recommended limit of 80dB for 40 hours per week, is exceeded.

- **Heeding the warning signs of hearing loss** - It is critical to not ignore early signs of noise damage. Tinnitus; problems in hearing highpitched sounds such as doorbells, phones or alarm clocks; difficulty in understanding speech especially over the telephone; and following conversations in noisy environments such as restaurants, are all signs that damage may have occurred.

### c. Tips for Safe Listening

Access the link

[https://cdn.who.int/media/docs/default-source/documents/health-topics/deafness-and-hearing-loss/tips-for-mls-en.pdf?sfvrsn=819242a0\\_5](https://cdn.who.int/media/docs/default-source/documents/health-topics/deafness-and-hearing-loss/tips-for-mls-en.pdf?sfvrsn=819242a0_5)

Keep in mind:

1. Keep the volume down
2. Protect your ears from loud sounds
3. Limit time spent engaged in noisy activities
4. Monitor listening levels.

- *Loud sounds damage ears!*
- *You could be at risk of noise-induced hearing loss if you: work in a noisy place, listen to audio over earphones*
- *Noise-induced hearing loss is permanent!*
- *Noise -induced hearing can be prevented!*

### Optional Application 5      *Soundscape Design*

minutes

5

„Urban **Soundscape Design** is fundamentally about intentionally shaping the urban sonic environment for human benefit.“ <https://climate.sustainability-directory.com/term/urban-soundscape-design/>

Use IA (Gemini, ChatGPT, Perplexity.ai, claude.ai, copilot, deepseek) for designing the soundscape (**Soundscape Design**). Respond to the following questions and note suggested links/articles.

Perplexity.ai:

**a. The meaning of the soundscape and how it can be intentionally controlled or created in cities.**

The meaning of the soundscape relates to the entire acoustic environment as perceived and experienced by people in a city. It includes all sounds present, from natural sounds like birdsong and wind, to human sounds such as speech and music, and technological sounds like traffic and machinery.

**b. Design strategies to introduce positive natural sounds in cities**

Design strategies to introduce positive natural sounds in cities focus on enhancing the auditory environment to improve well-being and quality of life. Some key strategies include:

- creating and maintaining green spaces like parks, tree-lined streets and gardens;
- incorporating water features such as fountains, ponds, and that provide soothing water sounds;
- using sound-absorbing materials (acoustic panel, absorptive pavements), vegetation as natural sound barriers to reduce harsh noise pollution;
- encouraging community participation in soundscape design to create culturally meaningful and conformable sonic environments.

**c. Find examples of urban projects or interventions that positively change acoustic quality.**

- **The High Line Park, New York City:** a former freight rail line transformed into an elevated park using sound-absorbing materials, strategic greenery, and seating placement to reduce traffic noise and create a tranquil urban oasis;
- **HafenCity Hamburg:** a redeveloped urban area explicitly incorporating soundscape design principles for better acoustic quality and livability through landscaping, quiet spaces and noise control;
- **Cheonggyecheon Stream, Seoul, South Korea:** revitalization of a polluted urban stream into a green area with water features and vegetation, after

removal of an overhead highway, resulting in a significant noise reduction and creation of a calm, natural public space.

Lisboa Sound Oasis:

- sound-absorbing landscape features such a dense native vegetation;
- ambient sound installations that play recorded natural sounds of Lisbon’s beaches, birds and gentle ocean waves, creating a calming atmosphere;
- smart noise sensors that monitor sound level in real time and adjust background soundscapes dynamically to maintain peacefulness;
- pedestrian pathways lined with aromatic plants and sound -diffusing materials to provide sensory relief during walks;
- community involvement through workshops where residents contribute to sound choices and help maintain the park.

## **Optional Application 6      *Measures for Noise Reduction***

5

*minutes*

- Groups access EEA link and list proposed noise control measures.
- Select 5 measures applicable locally.
- Link:  
<https://www.eea.europa.eu/en/analysis/publications/environmental-noise-in-europe-2025/terminology-and-examples-of-types-of-noise-management-and-mitigation-measures>

## **Conclusions and Evaluation (5 minutes)**

- Students share what they learned, dangers of noise, and how to protect themselves.
- Emphasize importance of limiting exposure and using earplugs at noisy events.

## **Follow-up – Optional Homework and Additional Activities**

- Noise measurements in the city with digital meter/app, upload data to Google Drive.
- Research and debate about new technologies for noise reduction (“Silent revolution”): active noise cancellation, smart cities, electric transport, sound design.
- Resources for homework:  
<https://webbrowsertools.com/sound-meter/>  
WHO flyer “Did you know 1 in 4 young people...”

<https://www.who.int/campaigns/world-hearing-day/2022/information-materials#cms>

## Recommendations for Students with Special Needs

- Provide supplementary visual aids such as diagrams, infographics, and simple videos explaining noise pollution concepts.
- Assign a peer buddy or support staff to assist with group work and technical use of sound meter apps.
- Use simplified instructions with clear, short sentences and visuals.
- Allow extra time for practical activities and discussions.
- Give students defined roles within groups to enable focused contributions.
- For students with hearing impairments, provide written transcripts of videos and use captions.
- Ensure accessibility of all digital platforms and apps used.

## Noise Pollution Quiz

**Instructions:** Choose the best answer for each question. Select only ONE option per question.

### 1. What is noise pollution?

- a) Any sound that is louder than 50 decibels.
- b) Unwanted or harmful sounds that disrupt the environment and human activities.
- c) Only sounds produced by industrial machinery.
- d) Natural sounds like thunder and wind.

### 2. At what decibel level does sound begin to pose a risk of hearing damage?

- a) 60 dB      b) 70 dB      c) 80 dB      d) 90 dB

### 3. Which of the following represents the decibel level that causes immediate pain or even deafness to the human ear?

- a) 100 dB      b) 120 dB      c) 140 dB      d) 160 dB

### 4. Which of these is considered a MOBILE source of noise pollution?

- a) Construction sites
- b) Factory machinery
- c) Air conditioning units
- d) Road traffic

**5. What does 0 dB represent on the decibel scale?**

- a) Complete silence (threshold of hearing)
- b) Normal conversation level
- c) The loudest sound humans can hear
- d) The sound of a whisper

**6. Which health effect is NOT typically associated with prolonged exposure to noise pollution?**

- a) Hearing loss
- b) Sleep disturbances
- c) Improved memory function
- d) Cardiovascular diseases

**7. According to the lesson, which organization provides data on noise pollution's effects at the European level?**

- a) WHO (World Health Organization)
- b) EEA (European Environment Agency)
- c) UNESCO
- d) UNICEF

**8. What type of noise source would a household appliance be classified as?**

- a) Mobile source
- b) Fixed source
- c) Natural source
- d) Temporary source

**9. Which of the following is an effective measure to reduce noise pollution in urban areas?**

- a) Increasing traffic speed limits
- b) Building more airports near residential areas
- c) Creating green zones and sound barriers
- d) Encouraging the use of louder car horns

**10. What is the main purpose of using a digital sound meter in the practical activity described in the lesson?**

- a) To create more noise in the environment
- b) To measure and record actual noise levels in different locations
- c) To play music at specific volumes
- d) To communicate with other students during group work

## Answer Key:

1. b) Unwanted or harmful sounds that disrupt the environment and human activities.
2. c) 80 dB
3. c) 140 dB
4. d) Road traffic
5. a) Complete silence (threshold of hearing)
6. c) Improved memory function
7. b) EEA (European Environment Agency)
8. b) Fixed source
9. c) Creating green zones and sound barriers
10. b) To measure and record actual noise levels in different locations

## LOUD AND CLEAR: THE SOUND EMERGENCY

### WE CAN'T IGNORE NOISE POLLUTIO

#### Handout - worksheet students

We will work on this topic in pairs. Open a Word document/Google Docs/phone notes/  
alternatively: a sheet of paper.

Write down your name and the topic. We can't ignore noise pollution. You will note down the  
completed applications one by one. Short and clear.

Application 1 10 minutes

#### Application 1 a

*Measuring sources of noise* 5 minutes

Access a noise pollution tool (free) <https://webbrowsertools.com/sound-meter/>

<b>a. Measurement 1</b>		
Let's all applaud this experience!	What is the unit of measurement? Db (Enter decibels). What are the recorded values?	Enter the recorded value.
<b>b. Measurement 2</b>		
Talk, as you usually do, with your classmate.	What are the recorded values?	Enter the recorded value.
<b>c. Measurement 3</b>		
Do you know the rhythm of Queen's famous song We Will Rock You? Let's try to keep the rhythm together.  <a href="https://www.youtube.com/watch?v=-tJYN-eG1zk">https://www.youtube.com/watch?v=-tJYN-eG1zk</a>	What are the recorded values?	Enter the recorded value.
<b>d. Measurement 4</b>		
And now, in a whisper, share with your colleague a conclusion about this experience.	What are the recorded values?	Enter the recorded value.

Application 1.b 5 minutes

Match the source of noise/sound with dB values.

Go to the following link, a wordwall exercise where you can match the source of noise/sound with dB values. You have 5 minutes. Check your answers. Have you learned anything new about noise pollution?

<https://wordwall.net/resource/96473638/nivelul-de-zgomot-intensitatea-sunetelor-%c3%aen-db>

## Application 2

**Brief Teaching – Noise Pollution: Definitions and Concepts** 10 minutes

Access the link <https://www.britannica.com/science/noise-pollution>

Read the text and briefly write down the answers to the following questions.

- What is noise pollution?
- What is the unit of measurement for sound intensity?
- How many decibels can the human ear detect? At how many decibels can hearing loss occur?
- Effects on humans and wildlife.

## Application 3

**Sources of Noise Pollution** 5 minutes

Access the link <https://noise.eea.europa.eu/>

Read the text and briefly write down the answers to the following questions.

- What are the most significant sources of noise pollution identified?
- Access the link <https://www.eea.europa.eu/themes/human/noise/sub-sections/noise-fact-sheets>

Noise country fact sheets 2021. Access the data for Portugal and for your country of origin. Are there any similarities? Note an example.

- What sources of noise pollution exist in your environment?

## Application 4

**Impact of Noise Pollution on Humans** 15minutes

- Access the link**  
<https://www.eea.europa.eu/en/analysis/publications/environmental-noise-in-europe-2025/biological-indirect-pathways-through-which-environmental-noise-impacts-health>

**Analyze the infographic.** *Biological indirect pathways through which environmental noise impacts health (infographic) and answers questions:*

1. What are the consequences of noise pollution?
  2. What are the indirect biological ways in which environmental noise affects health?
  3. Identify four effects on the body's systems and processes.
- b. Access the **WHO (World Health Organization) link, a document created for World Hearing Day (March 3)**. Browse through the following pages:
- Hearing loss: Key facts (pg.2, 3);
  - Impact of hearing loss (pg.4, 5);
  - How can hearing be protected? (pg.9, 10).

[https://cdn.who.int/media/docs/default-source/documents/health-topics/deafness-and-hearing-loss/j0041\\_mls\\_whd\\_media\\_toolkit\\_singles\\_web\\_v12.pdf?sfvrsn=fe410198\\_10&download=true](https://cdn.who.int/media/docs/default-source/documents/health-topics/deafness-and-hearing-loss/j0041_mls_whd_media_toolkit_singles_web_v12.pdf?sfvrsn=fe410198_10&download=true)

1. For each section, note 2-3 aspects that caught your attention. Formulate a conclusion.
2. What is the impact of noise pollution on the environment and people? Give an example.
3. What are the values that should not be exceeded? How can we avoid hearing loss?

### c. Tips for Safe Listening

Access the link [https://cdn.who.int/media/docs/default-source/documents/health-topics/deafness-and-hearing-loss/tips-for-mls-en.pdf?sfvrsn=819242a0\\_5](https://cdn.who.int/media/docs/default-source/documents/health-topics/deafness-and-hearing-loss/tips-for-mls-en.pdf?sfvrsn=819242a0_5)

Keep in mind:

5. Keep the volume down!
6. Protect your ears from loud sounds!
7. Limit time spent engaged in noisy activities!
8. Monitor listening levels.
  - *Loud sounds damage ears!*
  - *You could be at risk of noise-induced hearing loss if you: work in a noisy place, listen to audio over earphones*
  - *Noise-induced hearing loss is permanent!*
  - *Noise -induced hearing can be prevented!*

## Optional Application 5

### *Soundscape Design*

*10 minutes*

„Urban **Soundscape Design** is fundamentally about intentionally shaping the urban sonic environment for human benefit.”

Access the link <https://climate.sustainability-directory.com/term/urban-soundscape-design/>

Use AI (Gemini, ChatGPT, Perplexity.ai, claude.ai, copilot, deepseek) for designing the soundscape (**Soundscape Design**). Respond to the following questions and note suggested links/articles.

- d. The meaning of the soundscape and how it can be intentionally controlled or created in cities.
- e. Design strategies to introduce positive natural sounds in cities
- f. Find examples of urban projects or interventions that positively change acoustic quality.
- g. Propose an imaginary project for a public space where noise is managed creatively, for your town.

## Optional Application 6

### *Measures for Noise Reduction* *minutes*

5

- Groups access EEA link and list proposed noise control measures.
- Select 5 measures applicable locally.
- Link:  
<https://www.eea.europa.eu/en/analysis/publications/environmental-noise-in-europe-2025/terminology-and-examples-of-types-of-noise-management-and-mitigation-measures>

## Noise Pollution Quiz

*Instructions: Choose the best answer for each question. Select only ONE option per question.*

### 1. What is noise pollution?

- a) Any sound that is louder than 50 decibels.
- b) Unwanted or harmful sounds that disrupt the environment and human activities.
- c) Only sounds produced by industrial machinery.
- d) Natural sounds like thunder and wind.

### 2. At what decibel level does sound begin to pose a risk of hearing damage?

- a) 60 dB
- b) 70 dB
- c) 80 dB
- d) 90 dB

### 3. Which of the following represents the decibel level that causes immediate pain or even deafness to the human ear?

- a) 100 dB
- b) 120 dB
- c) 140 dB
- d) 160 dB

### 4. Which of these is considered a **MOBILE** source of noise pollution?

- a) Construction sites
- b) Factory machinery
- c) Air conditioning units
- d) Road traffic

### 5. What does 0 dB represent on the decibel scale?

- a) Complete silence (threshold of hearing)
- b) Normal conversation level
- c) The loudest sound humans can hear
- d) The sound of a whisper

### 6. Which health effect is **NOT** typically associated with prolonged exposure to noise pollution?

- a) Hearing loss
- b) Sleep disturbances
- c) Improved memory function
- d) Cardiovascular diseases

### 7. According to the lesson, which organization provides data on noise pollution's effects at the European level?

- a) WHO (World Health Organization)
- b) EEA (European Environment Agency)
- c) UNESCO
- d) UNICEF

**8. What type of noise source would a household appliance be classified as?**

- a) Mobile source
- b) Fixed source
- c) Natural source
- d) Temporary source

**9. Which of the following is an effective measure to reduce noise pollution in urban areas?**

- a) Increasing traffic speed limits
- b) Building more airports near residential areas
- c) Creating green zones and sound barriers
- d) Encouraging the use of louder car horns

**10. What is the main purpose of using a digital sound meter in the practical activity described in the lesson?**

- a) To create more noise in the environment
- b) To measure and record actual noise levels in different locations
- c) To play music at specific volumes
- d) To communicate with other students during group work



## LOUD AND CLEAR: THE SOUND EMERGENCY WE CAN'T IGNORE NOISE POLLUTION

### Handout - worksheet students

#### Application 1 a -Measuring sources of noise

Access a noise pollution tool (free) <https://webbrowsertools.com/sound-meter/>

Note the value recorded for each measurement.

1. _____ dB	2. _____ dB	3. _____ dB	4. _____ dB
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#### Application 1.b - Match the source of noise/sound with dB values.

<https://wordwall.net/resource/96473638/nivelul-de-zgomot-intensitatea-sunetelor-%c3%aen-db>

#### Application 2- Brief Teaching – Noise Pollution: Definitions and Concepts

Access the link <https://www.britannica.com/science/noise-pollution>

Read through the information and answer the following questions briefly.

e. What is noise pollution?

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f. What is the unit of measurement for sound intensity?

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g. How many decibels can the human ear detect? At how many decibels can hearing loss occur?

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h. Effects on humans and wildlife.

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### Application 3

Access the link <https://noise.eea.europa.eu/>

Read through the information and answer the following questions briefly.

a. What are the most significant sources of noise pollution identified?

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b. Access the link <https://www.eea.europa.eu/themes/human/noise/sub-sections/noise-fact-sheets>

Noise country fact sheets 2021. Access the data for Portugal and for your country of origin. Are there any similarities? Note an example.

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What sources of noise pollution exist in your environment?

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### Application 4

d. Access the link <https://www.eea.europa.eu/en/analysis/publications/environmental-noise-in-europe-2025/biological-indirect-pathways-through-which-environmental-noise-impacts-health> Analyze the infographic.

4. What are the consequences of noise pollution?

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5. What are the indirect biological ways in which environmental noise affects health?



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6. Identify four effects on the body's systems and processes.

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e. Access the WHO (World Health Organization) link, a document created for World Hearing Day (March 3). Browse through the following pages:

[https://cdn.who.int/media/docs/default-source/documents/health-topics/deafness-and-hearing-loss/j0041\\_mls\\_whd\\_media\\_toolkit\\_singles\\_web\\_v12.pdf?sfvrsn=fe410198\\_10&download=true](https://cdn.who.int/media/docs/default-source/documents/health-topics/deafness-and-hearing-loss/j0041_mls_whd_media_toolkit_singles_web_v12.pdf?sfvrsn=fe410198_10&download=true)

4. For each section, note 2-3 aspects that caught your attention. Formulate a conclusion.

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5. What consequences does excessive noise have on human life and the environment?

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6. What are the values that should not be exceeded? How can we avoid hearing loss?

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f. Tips for Safe Listening

[https://cdn.who.int/media/docs/default-source/documents/health-topics/deafness-and-hearing-loss/tips-for-mls-en.pdf?sfvrsn=819242a0\\_5](https://cdn.who.int/media/docs/default-source/documents/health-topics/deafness-and-hearing-loss/tips-for-mls-en.pdf?sfvrsn=819242a0_5)

Keep in mind:

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## Optional Application 5      *Soundscape Design*

5

minutes

Access the link .” <https://climate.sustainability-directory.com/term/urban-soundscape-design/>

Use AI for designing the soundscape designs. Discuss in pairs the following topics:

1. The meaning of the soundscape and how it can be intentionally controlled or created in cities.
2. Find examples of urban projects or interventions that positively change acoustic quality.
3. Propose an imaginary project for a public space where noise is managed creatively, for your town (ex. Lisbon)

## Noise Pollution Quiz - Multiple Choice

**Instructions:** Choose the best answer for each question. Select only ONE option per question.

### 1. What is noise pollution?

- a) Any sound that is louder than 50- 55 decibels.
- b) Unwanted or harmful sounds that disrupt the environment and human activities.
- c) Only sounds produced by industrial machinery.
- d) Natural sounds like thunder and wind.

### 2. At what decibel level does sound begin to pose a risk of hearing damage?

- a) 60 dB
- b) 70 dB
- c) 80 dB
- d) 90 dB

### 3. Which of the following represents the decibel level that causes immediate pain or even deafness to the human ear?

- a) 100 dB
- b) 120 dB
- c) 140 dB
- d) 160 dB

### 4. Which of these is considered a MOBILE source of noise pollution?

- a) Construction sites

- b) Factory machinery
- c) Air conditioning units
- d) Road traffic

**5. What does 0 dB represent on the decibel scale?**

- a) Complete silence (threshold of hearing)
- b) Normal conversation level
- c) The loudest sound humans can hear
- d) The sound of a whisper

**6. Which health effect is NOT typically associated with prolonged exposure to noise pollution?**

- a) Hearing loss
- b) Sleep disturbances
- c) Improved memory function
- d) Cardiovascular diseases

**7. According to the lesson, which organization provides data on noise pollution's effects at the European level?**

- a) WHO (World Health Organization)
- b) EEA (European Environment Agency)
- c) UNESCO
- d) UNICEF

**8. What type of noise source would a household appliance be classified as?**

- a) Mobile source
- b) Fixed source
- c) Natural source
- d) Temporary source

**9. Which of the following is an effective measure to reduce noise pollution in urban areas?**

- a) Increasing traffic speed limits
- b) Building more airports near residential areas
- c) Creating green zones and sound barriers



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d) Encouraging the use of louder car horns

**10. What is the main purpose of using a digital sound meter in the practical activity described in the lesson?**

a) To create more noise in the environment

b) To measure and record actual noise levels in different locations

c) To play music at specific volumes

d) To communicate with other students during group work

## **Lesson 3. Carbon Footprint – Complex Analysis and Global Implications**

**General Objective:** To understand the concept of a carbon footprint, compare this indicator for different countries, and identify ways to reduce one's own carbon footprint

## Objectives

- Define the carbon footprint including other greenhouse gases (methane, nitrous oxide) and their climatic impact.
- Analyze the systemic connections between human activities, carbon emissions, and global climate change.
- Critically interpret global carbon footprint data, identifying imbalances between countries and regions.
- Calculate a detailed personal carbon footprint and evaluate lifestyle sustainability.
- Develop a sustainable and well-argued action plan considering individual and collective impacts.
- Debate international climate policies and the role of individual responsibility in relation to collective accountability.

## Learning Outcomes

Students will be able to:

- Explain the role of various greenhouse gases and their combined effect in carbon footprint calculations.
- Use global databases for advanced statistical and graphical comparisons.
- Critically assess correlations between economic development, wealth distribution, and CO<sub>2</sub> emissions.
- Reflect on their personal consumption patterns and their global impact.
- Argue a position before the class about a reduction plan that incorporates elements of climate justice.
- Understand and discuss relevant climate policies and global initiatives (Paris Agreement, Green New Deal, etc.).

## Methodology

- Flipped classroom with complex materials: videos, scientific articles, and adapted IPCC reports.
- Data analysis: students work with real data sets (Our World in Data) and interpret and visualize information.

- Structured argumentative debates with assigned roles (economic actors, environmentalists, government representatives).
- Collaborative report and plan writing in Google Docs and complex presentations in Google Slides.
- Use of advanced digital tools (Canva, Mentimeter, Excel/Google Sheets for charts).
- Socratic dialogue and meta-cognitive reflection throughout all stages.

## References

- Introductory video: [https://www.youtube.com/watch?v=8q7\\_aV8eLUE](https://www.youtube.com/watch?v=8q7_aV8eLUE)
- Fundamental Britannica article: <https://www.britannica.com/science/carbon-footprint>
- Detailed CO2 and other gas emissions data: <https://ourworldindata.org/grapher/co-emissions-per-capita?tab=table> and <https://ourworldindata.org/co2-emissions-metrics>
- Detailed personal footprint calculator: <https://www.footprintcalculator.org/home/en>
- Feedback and anonymous survey platform: <https://www.mentimeter.com/>  
To create a mind map <https://www.canva.com/graphs/mind-maps/>
- Intergovernmental IPCC reports (adapted and summarized for students)

## Teaching Materials

- Laptops/tablets with access to advanced software (Google Suite, Canva, Excel)
- Tableau or Google Sheets for data visualization and analysis
- Interactive whiteboard for presentations and simulations
- Digital study documents (reports, articles)
- Digital post-its and Mentimeter platform for feedback and reflections
- If necessary, use A3 or poster paper, post-it notes.

## Lesson Development

**Duration: 60 minutes**

### **The teacher announces how the lesson will proceed**

- we will work on this topic in pairs;
- we have access to the internet via laptops or smartphones;
- open a Word document, Google Docs, phone notes; alternatively: a sheet of paper. Write down your name and the topic. We can't ignore noise pollution. You will note down the completed applications one by one. Short and clear.

- at the end of the lesson, you will upload your answers to the classroom or wherever your teacher directs you. Alternatively, the sheets will be handed in to the teacher.

**Application 1** *Warm-up exercise* 5 minutes

- Students analyze complex images and graphs on sectoral and national carbon footprints.
- Divided into roles, they prepare brief arguments on the importance of footprint reduction related to different interests (industrial, environmental, social).

*Appendix 1*

- Rapid debate to stimulate critical thinking and identify the problem's complexity.

**Application 2** *Defining the Carbon Footprint* 15 minutes

**If possible flipped classroom**

1. Defining carbon footprint and greenhouse gases

- Individual study through video and texts.
- In-class in-depth discussion and definition of key terms.

Reference:

- [https://www.youtube.com/watch?v=8q7\\_aV8eLUE](https://www.youtube.com/watch?v=8q7_aV8eLUE)

Access the link below.

- <https://www.britannica.com/science/carbon-footprint>

2. Understanding how human activities contribute to carbon emissions. After watching the video, students answer the following questions:

- a. How does the carbon footprint influence the planet? Identify consequences.
- b. What activities have an impact on carbon footprint?
- c. How can we contribute to reducing the carbon footprint?
- d. Optional: Creating a Mind Map/Graphic Organizer

**Application 3** *Use Our World in Data to interpret statistics* 10 minutes

Analyzes data and answers questions:

1. Which countries have the highest carbon dioxide emissions?
2. On which continent are most of the countries with the lowest carbon dioxide emissions located? Why?
3. Compare global carbon dioxide emissions for 1900 and 2000. What do you notice?

Reference:

- <https://ourworldindata.org/co2-emissions-metrics>

## Appendix 2

### Application 4

### *Lifestyle and personal footprint*

15 minutes

- a. Each student accesses the link and obtains data about their carbon footprint. Students write down their answers to the following questions.

Reference: <https://www.footprintcalculator.org/home/en>

- What date would your personal Earth Overshoot Day be?
- How many Earths would be needed if everyone lived like you?
- Why can't I get my Carbon Footprint score within the means of one planet?

- b. Students compare, in pairs, the results obtained

Detailed personal footprint calculation and Earth Overshoot Day interpretation.

Using Mentimeter (<https://www.mentimeter.com/>), anonymously submit your Earth Overshoot Day and how many Earths would be needed. Review the class ranking presented after submissions

- Use <https://www.mentimeter.com/> to create a class ranking.
- Note down the date of your personal Earth Overshoot Day (format DD.MM.YYYY).
- The goal is not to judge, but to make students aware of the differences and to learn from one another. Ensure that students feel comfortable sharing their results. Mentimeter helps with anonymity.

- c. Reflect on how personal consumption impacts the planet.

- Identifying ways each person can reduce their carbon footprint.
- Analyze the impact of personal versus collective responsibility.

### Application 5

### *Find 5 ways to reduce your carbon footprint in daily life*

10 minutes

- In groups of 4 students, find 5 ways to reduce your carbon footprint in daily life.

#### **Instructions:**

- Each group will have a dedicated slide.
- On your slide, write 5 concrete ways to reduce your carbon footprint in daily life (at home, at school, in your free time).
- Use emoticons to categorize each method.
  - Use emoticons to rank the identified methods:

- High Impact 😊
- Medium Impact 😊
- Difficult to implement 😞

Choose high-impact methods and assign them a keyword/acronym.

- At the end (the final 5 minutes of the 15), each group can quickly present their chosen methods and acronym.

The teacher should be constantly connected with the students to provide guidance and ensure they have understood the task.

## Digital Tools Used

- YouTube and Britannica for information
- Our World in Data for advanced data analysis
- Footprint Calculator for personalized calculations
- Excel / Google Sheets for data visualization and charts
- Canva/or other applications for creating complex mind maps and infographics
- Google Slides and Docs for collaboration and reporting
- Mentimeter for anonymous feedback and interactive surveys

## Assessment

- Participation and quality of arguments in structured debates.
- Quality of analyses and data visualizations created.
- Coherence and originality of developed action plans.
- Quizzes with Kahoot/Wordwall including case studies and data analysis.
- Documented reflections and personal commitments digitally filed.

## Follow-up

- Monitor progress via periodic discussions focusing on concrete indicators.
- Encourage participation in school and community sustainability projects.
- Develop a digital journal of actions and personal footprint impact.
- Promote ongoing dialogue about climate change and everyone's role in solutions.

Appendix 1 *Annual CO<sub>2</sub> emissions. Top 10 countries.*

## Guess the Carbon Footprint

- Analyzes the following images.
- Which activity do you think produces the largest carbon footprint per year?
- Rank the carbon footprint that results, from largest to smallest.
- Justify your choice.



The correct order: bus > cheeseburger > phone > bicycle

Brief discussions; there are no wrong answers, only opinions.

Connection to the topic:

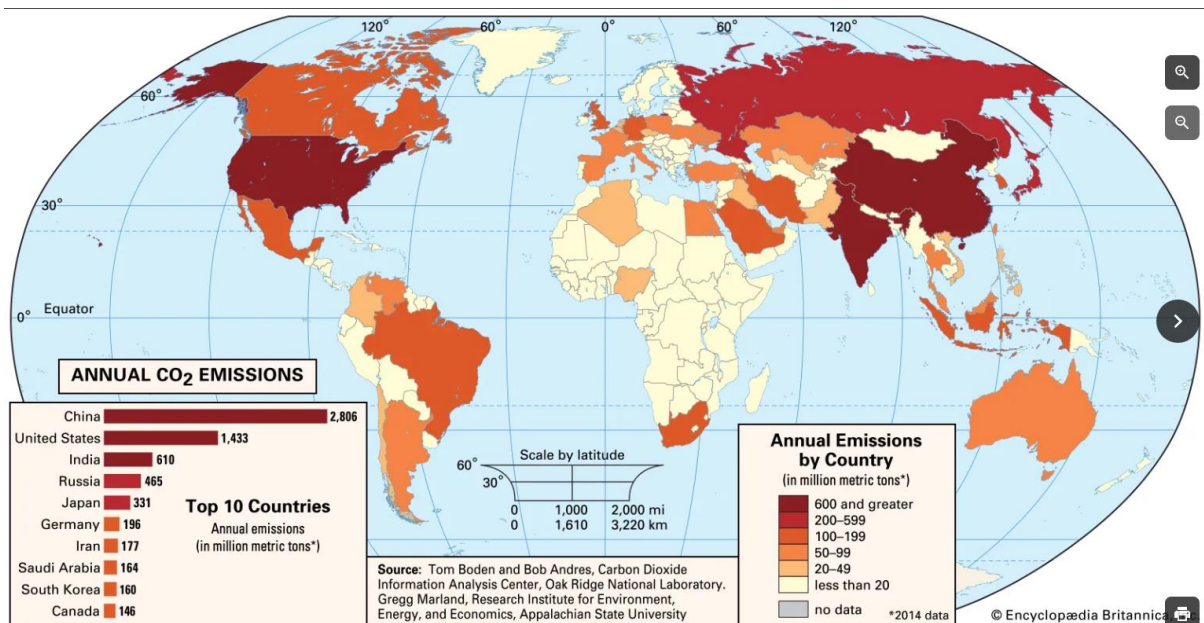
At the end of the discussion, you can make a short transition to the question:

- What does this carbon footprint actually mean?
- Why is it important to understand it?

## Recommendations for Students with Special Needs

- Provide supplementary visual aids such as diagrams, infographics, and simple videos explaining noise pollution concepts.
- Assign a peer buddy or support staff to assist with group work and technical use of sound meter apps.
- Use simplified instructions with clear, short sentences and visuals.
- Allow extra time for practical activities and discussions.
- Give students defined roles within groups to enable focused contributions.
- For students with hearing impairments, provide written transcripts of videos and use captions.
- Ensure accessibility of all digital platforms and apps used.

## Appendix 2 *Annual CO<sub>2</sub> emissions. Top 10 countries*



<https://www.britannica.com/science/greenhouse-gas>

## DEFINING THE CARBON FOOTPRINT AND EXPLAINING ITS ENVIRONMENTAL IMPACT

### LESSON DEVELOPMENT (for the teacher)

- We will work on this topic in pairs. Open a Word document/Google Docs/phone notes/ alternatively: a sheet of paper.
- Write down your name and the topic. We can't ignore noise pollution. You will note down the completed applications one by one. Short and clear.
- At the end of the lesson, you will upload your answers to the classroom or wherever your teacher directs you. Alternatively, the sheets will be handed in to the teacher

### What is the carbon footprint?

- It represents the totality of greenhouse gas emissions, primarily CO<sub>2</sub> (carbon dioxide), resulting from human activities or a company.
- It contributes to global warming and climate change with major consequences for the planet.

**Application 1**  
minutes

*Warm-up Exercise*

10

### Guess the Carbon Footprint

- Analyze the following images.
- Which activity do you think produces the largest carbon footprint per year?
- Rank the resulting carbon footprints from largest to smallest.
- Justify your choice.



Licensed by Google

\* \*\*Correct Order:\*\* bus > cheeseburger > phone > bicycle



## c. How can we contribute to reducing our carbon footprint?

- **Use renewable energy:** Switch to solar, wind, or other clean energy sources.
- **Reduce energy consumption:** Improve efficiency by using less electricity and heating
- **Sustainable consumption:** Buy fewer products and choose those with a smaller environmental impact.
- **Recycle and reuse:** Give products a second life instead of sending them to a landfill.
- **Sustainable agriculture and industry:** Support companies that use eco-friendly practices to produce goods and food.

## d. Optional: Creating a Mind Map/Graphic Organizer

Create a mind map individually or in pairs using a tool like Canva's mind map feature. Your map should include the following:

- The definition of a carbon footprint.
- Examples of activities that generate it.
- The overall impact of the carbon footprint on the environment.

### Application 3      *Use Our World in Data to interpret statistics*      10 minutes

#### Comparing the carbon footprint by country

Access the link <https://ourworldindata.org/co2-emissions-metrics>

Or the Appendix 2 *Annual CO2 emissions. Top 10 countries*

1. Which countries have the highest carbon dioxide emissions?
2. On which continent are most of the countries with the lowest carbon dioxide emissions located? Why?
3. Compare global carbon dioxide emissions for 1900 and 2000. What do you notice?

### Application 4      *Lifestyle and personal footprint*      15 minutes

#### a. Calculating your Carbon Footprint

As a flipped classroom activity, students will access the link below at home.

In class, they will interpret the results and have discussions or reflections.

If not, they will solve the application in its entirety, in class

Reference: <https://www.footprintcalculator.org/home/en>

Students write down their answers to the following questions.

- **What date would your personal Earth Overshoot Day be?**
    - *Example: Your personal Earth Overshoot Day?*
  - **How many Earths would be needed if everyone lived like you?**
    - *Example: If everyone lived like you, we would need ?*
  - **Why can't I get my Carbon Footprint score within the means of one planet?**
    - *Example: Why can't I get my Footprint score within the means of one planet?*
  - **Note down the details of your score.**
- b. Compare your result with your desk partner's.**
- Use <https://www.mentimeter.com/> to create a class ranking.
  - Note down the date of your personal Earth Overshoot Day (format DD.MM.YYYY).
  - The goal is not to judge, but to make students aware of the differences and to learn from one another. Ensure that students feel comfortable sharing their results. Mentimeter helps with anonymity.

### Guided Discussion

- After the ranking is complete, you can ask questions like:
  - What do you notice in the class ranking?
  - Are there big differences?
  - Why do you think these differences exist?
- c. Reflect on how personal consumption impacts the planet.**

Identifying ways each person can reduce their carbon footprint.

**Application 5** *Find 5 ways to reduce your carbon footprint in daily life.* 10 minutes

- Collaborative Brainstorming (15 minutes) using Google Slides
- In groups of 4 students, find 5 ways to reduce your carbon footprint in daily life.

### Instructions:

- Each group will have a dedicated slide.
- Brainstorm and write, on your slide, 5 concrete ways to reduce your carbon footprint in daily life (at home, at school, in your free time).
- Use emoticons to categorize each method.
  - Use emoticons to rank the identified methods:



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- High Impact 😊
  - Medium Impact 😊
  - Difficult to implement 😞
- Choose high-impact methods and assign them a keyword/acronym.
  - At the end (the final 5 minutes of the 15), each group can quickly present their chosen methods and acronym.

The teacher should be constantly connected with the students to provide guidance and ensure they have understood the task.

## e. Follow-up

One thing they learned and one action they will take to reduce their carbon footprint.

Have them note these down on a physical or digital post-it (e.g., Mentimeter).

**Connecting to real life:** Encourage students to be specific with their planned action. For example, they should say, "I will turn off the light when I leave a room," instead of "I will recycle more," or "I will separate plastic from paper."

## f. Assessment

- **Ongoing systematic observation:** Note students' involvement in discussions and group activities.
- The quality of ideas and the classification in Google Slides/word document

## DEFINING THE CARBON FOOTPRINT AND EXPLAINING ITS ENVIRONMENTAL IMPACT

(students)

### What is the carbon footprint?

- It represents the totality of greenhouse gas emissions, primarily CO<sub>2</sub>(carbon dioxide), resulting from human activities or a company.
- It contributes to global warming and climate change with major consequences for the planet.

### Application 1

### Warm-up Exercise

10 minutes

#### g. Warm-up Exercise (5 min)

Guess the Carbon Footprint.

- Analyze the following images.
- Which activity do you think produces the largest carbon footprint per year?
- Rank the resulting carbon footprints from largest to smallest.
- Justify your choice.



1



2



3



4

### Application 2

### Defining the Carbon Footprint

15 minutes

- In class, watch the film listed below.

[https://www.youtube.com/watch?v=8q7\\_aV8eLUE](https://www.youtube.com/watch?v=8q7_aV8eLUE)

## 2. Understanding how human activities contribute to carbon emissions

**Reference:** <https://www.britannica.com/science/carbon-footprint>

*Appendix 2. Annual CO<sub>2</sub> emissions*

After watching the video and access the Britannica.com students answer the following questions:

- i. How does the carbon footprint influence the planet? Identify consequences.
- j. What activities have an impact on carbon footprint?
- k. How can we contribute to reducing the carbon footprint?
- l. Optional: Creating a Mind Map/Graphic Organizer

### Application 3

*Use Our World in Data to interpret statistics*

10 minutes

Access the link <https://ourworldindata.org/co2-emissions-metrics>

4. Which countries have the highest carbon dioxide emissions?
5. On which continent are most of the countries with the lowest carbon dioxide emissions located? Why?
6. Compare global carbon dioxide emissions for 1900 and 2000. What do you notice?

### Application 4

*Lifestyle and personal footprint*

15

minutes

#### a. Calculating Your Personal Carbon Footprint

Access the link below and compare the results. Discuss with your classmates in class

<https://www.footprintcalculator.org/home/en>

- What date would your personal Earth Overshoot Day be?
- How many Earths would be needed if everyone lived like you?
- Why can't I get my Carbon Footprint score within the means of one planet?
- Note down the details of your score.

#### b. Compare your result with your desk partner's.

- Use <https://www.mentimeter.com/> to create a class ranking.
- Note down the date of your personal Earth Overshoot Day (format DD.MM.YYYY).
- The goal is not to judge, but to make students aware of the differences and to learn from one another. Ensure that students feel comfortable sharing their results. Mentimeter helps with anonymity.

#### c. Reflect on how personal consumption impacts the planet.

Identifying ways each person can reduce their carbon footprint.

#### d. Optional: Creating a Mind Map/Graphic Organizer



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Create a mind map individually or in pairs using a tool like Canva's mind map feature. Your map should include the following:

- The definition of a carbon footprint.
- Examples of activities that generate it.

The overall impact of the carbon footprint on the environment

**Application 5** *Find 5 ways to reduce your carbon footprint in daily life.* 10 minutes

## Collaborative Brainstorming (15 minutes) using Google Slides

- In groups of 4 students, find 5 ways to reduce your carbon footprint in daily life.

### Instructions:

- Each group will have a dedicated slide.
- On your slide, write 3 concrete ways to reduce your carbon footprint in daily life (at home, at school, in your free time).
- Use emoticons to categorize each method.
  - Use emoticons to rank the identified methods:
    - High Impact 😊
    - Medium Impact 😄
    - Difficult to implement 😞
- Choose high-impact methods and assign them a keyword/acronym.
- At the end (the final 5 minutes of the 15), each group can quickly present their chosen methods and acronym.

**Appendix 1** - Read the following texts

## What is the carbon footprint?

- It represents the totality of greenhouse gas emissions, primarily CO<sub>2</sub> (carbon dioxide), resulting from human activities or a company.
- It contributes to global warming and climate change with major consequences for the planet.

## Encyclopedia Britannica

"The concept of a carbon footprint is related to the older idea of an ecological footprint, a concept invented in the early 1990s by Canadian ecologist William Rees and Swiss-born regional planner Mathis Wackernagel at the University of British Columbia. The ecological footprint is the total land area required to support an activity or a population. This includes environmental impacts such as water usage and the amount of land used for food production. In contrast, the carbon footprint is usually expressed as a measure of weight, in tons of CO<sub>2</sub> or CO<sub>2</sub> equivalent per year."

## Calculating the Carbon Footprint

"Carbon footprints are different from a country's reported per capita emissions (e.g., those reported under the United Nations Framework Convention on Climate Change). Rather than greenhouse gas emissions associated with production, the carbon footprint focuses on greenhouse gas emissions associated with consumption. This includes emissions associated with goods that are imported into a country but are produced elsewhere and generally takes into account emissions associated with international



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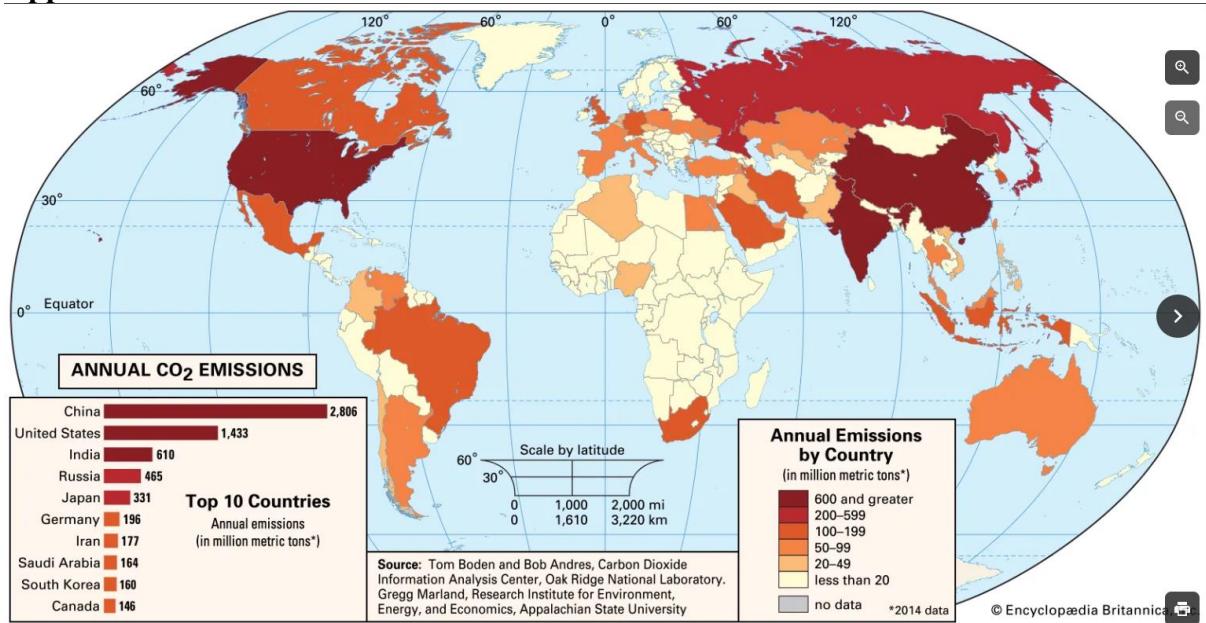
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transport and shipping, which are not accounted for in standard national inventories. As a result, a country's carbon footprint can increase even if carbon emissions from within its borders decrease."

Source: <https://www.britannica.com/science/carbon-footprint>

## Appendix 2. Annual CO<sub>2</sub> emissions



<https://www.britannica.com/science/greenhouse-gas>

## Module 3: Sustainable Energy Technologies

### Objectives:

- To provide students with a meaningful educational experience that links digital technology use with environmental awareness;
- To deepen students' understanding of energy sustainability while enabling them to explore modern digital tools;
- To challenge students to investigate, analyse, organise, and communicate information in a clear and visually appealing manner;
- To foster critical thinking, teamwork, and a sense of social and ecological responsibility.

### Learning outcomes:

By the end of this module 3, participants / students will be able to:

- demonstrate a clear understanding of sustainable energy concepts and the growing relevance of green technologies in today's environmental context;
- identify different types of renewable energy (such as solar, wind, and biomass), and also understand their benefits, applications, and limitations;
- use ChatGPT effectively as a research tool, capable of guiding inquiry, reformulating texts, generating examples, and organising ideas coherently;
- synthesise information into a digital poster that is informative, attractive, and well-structured;
- present their work with clarity and confidence, demonstrating critical reflection on the collaborative process and recognising the value of technology as a support for learning, creativity, and effective communication.

### Methodology:

The module was designed around a desired and active final product based on a project-based learning approach.

**The production and presentation of a Digital Poster on a sustainable technology.**

### Different stages for the activity:

- Knowledge activation (Brainstorming and feedback)

- Guided research using ChatGPT (to promote personalisation, student engagement, and autonomy)
- Collaborative group work
- Interactive presentations
- Reflection activities to consolidate Sustainable Energy Technologies.

The integration of accessible digital tools encourages innovation and real-world connections, while supporting the development of transversal skills crucial for the students' academic and personal growth.

**Duration:** 3 hours

## References:

Tester, J. W., et al. Sustainable Energy: Choosing among Options. MIT Press  
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“Integrating Energy and Sustainability into the Educational Curriculum.” Martínez-Borreguero, G., et al. Sustainability, 2024.

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<https://www.nature.com/articles/s41598-024-80640-7>



## Lesson 1- Knowing and Creating: Exploring Sustainable Energy Technologies

### Objective:

The main objective of this lesson is to introduce students to the concept of sustainable energy, encouraging critical and creative engagement with the importance of green technologies in addressing climate change. At the same time, students are empowered to use digital tools (ChatGPT and Canva) for research, idea organisation, and information communication.

By the end of the session, students should be ready to structure key knowledge about renewable energy sources, preparing to create an informative and visually appealing digital poster.

**Duration: around 60 minutes**

### Teaching Materials:

- Computer and projector
- Internet connection (wifi)
- Video session: to raise awareness of environmental preservation and the responsible use of natural resources.

Youtube video 1: <https://www.youtube.com/watch?v=WmVLcj-XXnM>

- Background music (optional): Lo-Fi Instrumental  
[https://www.youtube.com/watch?v=guSre\\_ewIJ8](https://www.youtube.com/watch?v=guSre_ewIJ8)
- Access to ChatGpt and Canva (create / install the accounts)

## **Description:**

Guidelines are given to participants (The session starts with a short video. The goals of the session are presented and explained to participants who are divided into small groups. They use ChatGPT as a research tool to explore different types of Renewable Energy (wind, solar, biomass).

Each participant analyses, summarizes and organizes the information as a draft to be used in the Canva poster. The focus is on developing digital literacy, critical thinking, and teamwork skills.

## **Methodology and Time Guidelines:**

Step 1. Warm-up Activity (10 minutes): Opening with an environmental awareness video, as well as an explanation of the objectives for the activity and the necessary tools.

Step 2. Group work (20 minutes). Participants use ChatGPT and guided research for the activity.

Step 3. Group sharing - Discussion and selection of key content (participants share and structure their ideas – 20 minutes).

Step 4. Layout of the digital poster in Canva (10 minutes).

## **Recommendations for Special Needs students:**

- Provide clear, visual, and oral instructions.
- Provide audio version of video and precise / short instructions.
- Ensure accessibility through screen reading software and communication support tools when required.
- Allow for flexible participation within groups, tailored to each student's ability.
- When applicable, students may contribute orally instead of in writing, or with support from peers or teachers (accept oral answers and allow voice recordings during the activity).
- Use printed worksheets instead of digital if needed.

## **Inventory of Digital Tools used:**

- ChatGPT (<https://chat.openai.com>)
- Canva (<https://www.canva.com>)
- YouTube – for introductory video (<https://www.youtube.com/watch?v=WmVLcj-XKnM>)
- Background music (optional): Lo-Fi Instrumental  
([https://www.youtube.com/watch?v=guSre\\_ewIJ8](https://www.youtube.com/watch?v=guSre_ewIJ8))

## Assessment:

- Formative assessment based on direct observation of student engagement in the proposed tasks.
- Criteria include group collaboration, relevance of the information gathered, clarity of idea organisation, and the initial structure of the poster.
- An informal oral reflection will be encouraged at the end of the session to identify learning outcomes and difficulties (contributions during presentations can be an option, as well as a reflection sheet: “What have I learned today?”).



## Lesson 2 - Creation and Communication: Information and Action

### Objective:

The main objective of this lesson is to consolidate and apply the knowledge acquired in the previous lesson by finalising the creation of the digital poster using Canva. Students will use the tool as a way for visual expression and clear communication on sustainable technologies. This session also aims to promote public speaking skills, creativity, and critical reflection on collaborative work and the use of Artificial Intelligence (ChatGPT) in students' learning process.

**Duration: about 60 minutes**

### Teaching Materials:

- Computer and projector
- Internet access (wifi)

- Multimedia projector and sound system
- Posters in progress on Canva
- Access to ChatGPT
- Screen or board for poster projection.

## **Description:**

The session starts with a brief review of previous work and group progress. Students return to their teams to complete the posters, using ChatGPT to refine text and improve the clarity and appeal of their message.

Each group presents their final work in a 2 or 3 minutes, supported by visual projection. The participants observe, vote, and ask questions.

The session ends with a collective reflection on:

- learning outcomes;
- challenges encountered;
- the impact of digital tools throughout the creative and informative process.

## **Methodology and Time Guidelines:**

Step 1. Revision lesson (5 minutes): Review of previous tasks and group organisation.

Step 2. Conclusion of the Poster on Canva (10 minutes): Poster finalisation with text and visual adjustments.

Step 3. Group presentations (about 30 minutes): Participants show their final work. They project their poster.

Step 4. Peer voting and group reflection (10 minutes).

## **Recommendations for Special Needs students:**

- Provide clear, visual, and oral instructions or assistance when needed.



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- Adapt tasks where appropriate, allowing more preparation time or alternative formats such as video, narration, or assisted delivery.
- Allow for flexible participation within groups, tailored to each student's ability.
- Students may contribute orally instead of in writing, or with support from peers or teachers (accept oral answers and allow voice recordings during the activity).
- Use printed worksheets instead of digital if needed.

## Inventory of Digital Tools used:

- Canva (<https://www.canva.com>)
- ChatGPT (<https://chat.openai.com>)
- YouTube – for background music ([https://www.youtube.com/watch?v=guSre\\_ewIJ8](https://www.youtube.com/watch?v=guSre_ewIJ8))

## Assessment:

- Formative assessment based on direct observation of student engagement, clarity, and creativity of Digital Poster.
- Assessment on the quality of the oral presentation and the integration of explored concepts.
- Assessment will also be based on the active participation during the process and the final informal reflection will be considered at the end of the session to identify learning outcomes and difficulties of the participants.
- Peer voting and self-assessment will support the recognition of individual and collective effort.



## Lesson 3 - From Creation to Action: Green Campaign at School

### Objective:

The main objective of this session is to use the digital posters created in the previous lesson as a basis for creating a real environmental awareness campaign.

Students will be challenged to think of practical and creative ways to use the materials to promote more sustainable behaviors within the school or through social media.

One of the ways could be the creation of a campaign that could take the form of presentations, physical applications in school spaces, content for the school's social media.

The goal is for students to understand that knowledge and creativity can be tools for transformation.

**Duration: 80 minutes**

### **Teaching materials:**

- Digital posters from the previous class
- Computers or tablets with Canva and ChatGPT (optional, for adjustments)
- Green campaign: planning sheet taking into account the target audience, objectives, key message, type of action, and resources needed
- Projector and speakers for presentations

### **Description:**

The session will begin with a brief review of the posters created in the previous lesson.

### **Students will be divided into groups and will have to consider the following guidelines:**

- How can we transform the content of our poster into an impactful action?
- Following the guidelines from the planning sheet, each group will design a simple and concrete campaign.
- Participants will present the poster to the public (guests).

This poster will be used as the basis for a video or post on the school's social media, or the creation of an awareness-raising campaign in public areas.

- After planning the activity (creation of a green awareness-raising campaign), each group will present their final project to the participants.

### **Methodological guidelines:**

Step 1. Review of posters and explanation of the task: transform into practical action (10 minutes).

Step 2. Group work: Planning the action based on the poster - Participants will follow the given guidelines to do a planning sheet. Each group will create a simple and concrete campaign plan presentation (40 minutes).

Step 3. Group presentation to the community (2–3-minute informal presentation each).

Step 4. Final reflection and completion of the survey (paper support or Google Forms) – about 15 minutes.

### **Recommendations for special needs students:**

- Differentiated support in planning activities.
- Flexibility in presentation format (video, oral, drawing).
- Close supervision by the teacher or assistant.
- Tasks assigned according to each student's strengths and interests.

### **Inventory of digital tools used:**

- Canva (<https://www.canva.com>)
- ChatGPT (<https://chat.openai.com>)
- Layout for a Campaign Planning Sheet
- Google Forms (survey)

### **Assessment:**

- Quality and feasibility of the proposed action.
- Clarity in presenting the plan.
- Ability to apply the content learned in a real-life situation.
- Active participation in the final reflection.



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## Layout for a Campaign Planning Sheet

**Complete the sheet below in your group, having in mind the poster you have created and the action you intend to implement:**

Group Name: \_\_\_\_\_

Participants' Names: \_\_\_\_\_

Campaign Title: \_\_\_\_\_

Sustainable Technology in Focus: \_\_\_\_\_

Campaign Objective: \_\_\_\_\_

Main Message to Communicate: \_\_\_\_\_

Campaign	Target	Audience:
_____		

Type of Action (presentation, collage, social media, event): \_\_\_\_\_  
\_\_\_\_\_

Action Description: \_\_\_\_\_

Materials and Resources Required: \_\_\_\_\_



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Tasks and Responsible Persons:

\_\_\_\_\_

Expected Date(s) for Implementation: \_\_\_\_\_

How will the campaign's effectiveness be measured? \_\_\_\_\_

## Module 4: Smart Waste Management Solutions

### Objectives:

- To introduce students to waste management challenges.
- To explore smart technologies (IoT, AI, sensors, apps) in managing waste efficiently.
- To enhance critical thinking, collaboration, and digital tool usage to design eco-innovative solutions.

### Learning outcomes:

By the end of this module, students will be able to:

- Explain key challenges in current waste management systems.
- Identify and evaluate smart technologies for waste collection and recycling.
- Use digital tools to model or present waste management innovations.
- Work collaboratively to suggest technology-based solutions for smart waste systems.

### Methodology:

- Interactive presentations
- Collaborative group work
- Real-world case study analysis
- Use of educational videos, digital modeling, and concept-mapping tools
- Guided exploration of smart technologies (e.g., sensors, apps, AI tools)
- Problem-solving through design-thinking tasks
- Digital poster creation using Canva and Google Slides
- Brainstorming and feedback using Padlet
- Student-led presentations and peer voting activities
- Reflection activities to consolidate eco-digital learning.

Duration: 3 hours

## References:

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## Lesson 1 - The Waste We Create

Objective:

- To help students identify different types of waste, explore how waste is generated and managed, and map local waste-related problems in their community or school.

Duration: 60 minutes

Teaching materials:

- Computer and projector
- Internet connection
- Kahoot or Quizizz (online quiz)
- Youtube video 1: “What Really Happens to the Plastic You Throw Away” – TED-Ed: [https://www.youtube.com/watch?v=\\_6xlNyWPpB8&ab\\_channel=TED-Ed](https://www.youtube.com/watch?v=_6xlNyWPpB8&ab_channel=TED-Ed)
- Youtube video 2: “Types of Waste - Waste Management Video - Waste Management Methods” - Learning Junction: [https://www.youtube.com/watch?v=H--LWj2KpoM&ab\\_channel=learningjunction](https://www.youtube.com/watch?v=H--LWj2KpoM&ab_channel=learningjunction)
- Miro (digital collaborative map).

Description:

Students begin the lesson with an engaging online quiz to test their knowledge and misconceptions about waste. This warm-up leads into two short educational videos: one on the journey of plastic waste (TED-Ed) and another about types of waste (Learning Junction). After guided discussion, students collaborate in small groups to map waste problems in their school or community using digital tools. By the end of the lesson, students will be able to describe major waste types, assess the environmental consequences of improper waste handling, and identify local improvement opportunities.

Methodological guidelines:

*Step 1. Warm-up Activity (10 minutes): Interactive Quiz*

- Prepare or use an existing quiz with 7–10 questions on Kahoot (<https://kahoot.com>) or Quizizz (<https://quizizz.com>):

Sample questions:

*Which of these takes the longest to decompose?*

*What is electronic waste (e-waste)?*

*How much plastic waste is recycled worldwide?*

*What is the average time it takes for a plastic bottle to decompose?*

*Which material is easiest to recycle?*

*What percentage of global plastic is recycled?*

- Run the quiz with students using their phones or devices. Show leaderboard to increase engagement.
- Discuss 2–3 surprising answers (e.g., plastic takes 450+ years to degrade, only about 9% of all plastic waste has ever been recycled).

## *Step 2. Video Sequence + Reflection (15 minutes)*

- Play Video 1: “What Really Happens to the Plastic You Throw Away” (TED-Ed, 4:07): [https://www.youtube.com/watch?v=\\_6xINyWPpB8](https://www.youtube.com/watch?v=_6xINyWPpB8) (This video explains the fate of plastic waste: landfill, incineration, ocean pollution).
- Use this video to introduce plastic pollution and recycling challenges.
- Ask students:  
*Which waste pathway is the most harmful?*  
*How does this relate to our daily lives?*
- Play Video 2: “Types of Waste – Waste Management Methods” (Learning Junction, 4:01): [https://www.youtube.com/watch?v=H--LWj2KpoM&ab\\_channel=learningjunction](https://www.youtube.com/watch?v=H--LWj2KpoM&ab_channel=learningjunction)
- Students learn about different types of waste — such as biodegradable, recyclable, electronic, and hazardous — and the common methods used to manage them, including recycling, composting, landfilling, and incineration.
- Ask after the video, ask students:  
*Which type of waste was new or surprising to you?*  
*Which waste management method do you think is best for your school or community?*  
*What are the risks of not separating waste correctly?*

## *Step 3. Group Activity – Waste Mapping (25 minutes)*

- Divide students into groups of 4–6.



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- Each group receives a Miro link to draw or digitally build a map of their school or local area.
- Ask students to identify 3–5 locations where waste accumulates (e.g., schoolyard, cafeteria, vending machines, park).
- Students have to use digital post-its to mark:
  - Type of waste* (plastic, food, paper, e-waste)
  - Problem* (overflow, littering, no bins)
  - Proposed solution* (bin placement, awareness signs, recycle bins)
- Examples:
  - Plastic bottles near vending machines → No recycling bin → Suggest placing colored recycle bins + sign*
  - Food waste in cafeteria → Overfilled bins → Suggest staggered collection schedule.*

## Step 4. Group Sharing (10 minutes)

- Each group presents one major problem they identified.
- Teacher helps categorize problems:
  - Lack of infrastructure*
  - Behavior issues*
  - System failures.*
- Guide a whole-class discussion:
  - Which problem happens most often?*
  - What are some small changes we could make?*
- As a class, create a list of “Top 3 Local Waste Issues” on the board, emphasizing the best solutions found.

## Recommendation for special needs students:

- Allow verbal instead of written input.
- Provide audio version of quiz and instructions.
- Offer pre-made maps for easier annotation.



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- Use visual templates and pre-labelled icons for types of waste.
- Assign tech-savvy peer partners during Miro activity.
- Accept oral answers and allow voice recordings during Miro activity.
- Assign buddy roles for group support.
- Use printed worksheets instead of digital if needed.

Inventory of digital tools used:

- Kahoot / Quizizz – Quiz: <https://kahoot.com>; <https://quizizz.com>
- YouTube – Educational videos: Youtube.com
- Miro – Digital collaborative map: <https://miro.com/education>

Assessment:

- Teacher observation using checklist: participation, understanding, teamwork.
- Group map clarity and relevance.
- Contributions during presentations.
- Optional student reflection sheet: “What’s one thing I learned today?”



## Lesson 2 Exploring Smart Waste Technologies: From Sensors to Apps

Objective:

- To expose students to digital innovations in smart waste management and enable them to analyze how these technologies address specific waste challenges through the use of sensors, apps, automation, and AI tools.

Duration: 50-60 minutes

Teaching materials:

- Internet-connected laptops or tablets (1 per group)
- Google Slides OR Canva (for poster creation)

- Padlet (for warm-up and group presentation)
- YouTube (for short smart tech demo videos)
- Pre-prepared Google Slides file or folder with 6–8 smart waste tech slides (shared by teacher)
- “Tech Comparison Questions” (digital worksheet or embedded in slide)

## Description:

Teachers will introduce the lesson with a digital warm-up on Padlet, where students respond to the question “What makes a waste solution smart?” by posting words, emojis, or examples. This encourages brainstorming and activates prior knowledge.

Students will then work in groups to explore and compare two smart waste technologies, such as sensor-equipped bins, AI sorting systems, composting apps, or gamified recycling platforms. Using shared digital tools like Google Slides or Canva, each group will create a poster that describes their assigned technologies, explains how they work, and makes a recommendation for school use.

The activity emphasizes digital collaboration, technology analysis, and critical thinking about how digital tools support sustainability.

## Methodological guidelines:

*Step 1. Warm-Up Activity (5–7 minutes): “What makes a waste solution smart?” (using Padlet)*

- Open your Padlet board and title it: “What makes a waste solution smart?”
- Ask students to post one idea, emoji, or example.
- They can write things like:
  - “Sends alerts when full”
  - “Can sort plastic vs. food”
  - “Uses solar panels ”
- This quick activity activates students’ prior knowledge and introduces the concept of technology in waste management.

*Step 2. Explore Smart Waste Solutions (15–20 minutes): Digital Gallery Walk in Groups*

- Prepare a Google Slides presentation (or a Google Drive folder) with 6–8 slides, each representing one smart waste solution.

Each slide should contain:

*A title (e.g., “Smart Bin with Sensors”)*

*A photo or icon*

*A short descriptive paragraph (see examples below)*

*A 1–2 minute video or animation (YouTube or embed) — optional but helpful*

- Assign groups (3–4 students per group). Each group selects or is assigned 2 smart waste technologies to explore.
- Share with students the “Smart Tech Comparison Template” via Google Slides or Canva.

Smart Waste Technologies (With Expanded Descriptions):

- You can copy/paste these directly into your slide deck or digital worksheet:

## 1. Smart Bins with Fill-Level Sensors

These bins are equipped with ultrasonic or infrared sensors that detect how full they are. When the bin reaches a certain level, it sends a wireless signal to waste management systems or apps, alerting that it needs to be emptied. This helps reduce overflow, optimize collection routes, and cut down emissions from garbage trucks. Common in smart cities, airports, and universities.

Digital Tech Involved: IoT (Internet of Things), real-time data, mobile app alerts

## 2. Reverse Vending Machines

These are automated machines that accept used beverage containers like plastic bottles or cans. When users deposit items, the machine scans the barcode and issues a digital reward like a discount code, eco-points, or even a small refund. The system promotes recycling through positive reinforcement.

Digital Tech Involved: Barcode scanning, digital wallets, reward systems

## 3. ShareWaste App

ShareWaste is a free mobile app that connects people who want to compost their organic waste with people who already compost at home, in schools, or in community gardens. Users can find local compost hosts and deliver their food scraps instead of sending them to landfill. The platform uses GPS and a friendly chat interface to build local compost networks.

Digital Tech Involved: GPS location mapping, mobile app, user accounts

#### 4. AI Waste Sorting Robot

These systems use computer vision and machine learning to scan items on a conveyor belt and sort them correctly — plastics, paper, metals, or landfill. This tech reduces human error and contamination in recycling facilities. Some models use robotic arms, others use air blasts to separate items.

Digital Tech Involved: Artificial intelligence, camera vision, robotics

#### 5. Smart Composting Units (Indoor or Outdoor)

Compact composting machines now use digital sensors to monitor temperature, moisture, and oxygen. Some even connect to a phone app to notify users when to stir, add browns/greens, or harvest finished compost. They speed up decomposition and help users track their eco-impact.

Digital Tech Involved: Sensors, app integration, timers

#### 6. Gamified Recycling App

These apps make recycling fun and competitive. Students can scan bins or sort items, earn points, badges, or climb leaderboards. Some school districts use these apps to track which classes recycle best and reward them monthly. Apps may also include quizzes, daily eco-challenges, and real-time tracking of progress.

Digital Tech Involved: QR code scanning, gamification features, leaderboards

Student Task:

- Visit or open the slides/folder with smart tech options.
- In their group, assign 2 technologies to analyze.
- Open the Smart Tech Comparison Slide and answer:
  1. *What is the purpose of this tech?*
  2. *What digital components does it use (sensor, app, camera, etc.)?*
  3. *What's one strength?*
  4. *What's one limitation?*
  5. *Would this work in our school? Why or why not?*

*Step 3. Create a Digital Poster (15 minutes):* Design a recommendation poster (Canva or Google Slides)

- Share a Canva template or Google Slides file titled “Smart Waste Tech Poster – Group Work”

- Each group builds 1 slide/poster that includes:

*Name and image of the 2 technologies they studied*

*Symbols/icons for pros and cons*

*A “Star Rating” (out of 5)*

*Their Top Recommendation for your school*

*A sentence like: “We recommend installing smart bins with sensors in the cafeteria because they reduce overflow and help plan collection schedules.”*

*Step 4. Share & Reflect (10–15 minutes)*

- Create a new Padlet board titled: “Which tech is best for schools?”
- Each group posts a screenshot of their poster and shortly present it.
- Students have to vote for the most creative solution or for which tech they would want in their school.

Recommendation for special needs students:

- Use audio feedback tools (e.g., Flip or voice notes in Slides).
- Provide simplified templates with sentence starters.
- Allow use of icons or emojis instead of text.
- Assign tech support buddies to assist in groups.
- Offer pre-filled choices of smart solutions to focus on.

Inventory of digital tools used:

- Padlet - Warm-up activity & peer feedback board: <https://padlet.com>



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- Google Slides Group work - comparison template, digital poster creation: <https://slides.google.com>
- Canva - Alternative tool for creating engaging digital posters: <https://www.canva.com>
- YouTube - Viewing 1–2 minute demo videos for each smart tech: <https://www.youtube.com>
- Google Docs (optional) - Hosting tech descriptions, activity instructions, or worksheets: <https://docs.google.com>
- Google Drive (optional) - Shared folder for case slides, templates, and team access: <https://drive.google.com>.

## Assessment:

- Participation in group work, understanding of smart technologies, and collaboration with team members.
- The poster includes two smart waste solutions, clear explanations, visuals, and a reasoned recommendation for the school context.
- Each student shared key points about their assigned technologies and responded to at least one question or comment from peers.



## Lesson 3 - Reimagine the Bin: Inventing the Future of Waste

### Objective:

- To empower students to apply their knowledge of smart waste management by designing a creative, technology-driven solution to a real waste problem using digital tools.

Duration: 55-60 minutes

### Teaching materials:

- Internet-connected devices (tablets/laptops)
- Padlet (for brainstorming warm-up)
- “Innovation Planning Template” (Google Slides or Docs)

- Optional: sample digital posters for inspiration
- Icons/ images library (via Canva or Google Images)

## Description:

Teachers introduce the lesson with a warm-up activity on Padlet to activate creativity and connect to students' previous learning about digital waste solutions.

Students work in small groups to identify a real waste-related problem in their school or community and then design their own digital smart waste solution, which could be a smart bin, app, robot, or platform. The lesson ends with short presentations of each invention, followed by optional digital voting or feedback.

## Methodological guidelines:

### *Step 1. Warm-Up – “If You Could Reinvent the Bin...” (5–7 minutes)*

- Open a Jamboard or Padlet titled “If you could reinvent the bin... what would it do?”
- Ask students to post:

*A feature (e.g., “speaks to you when you throw wrong”)*

*An emoji*

*A sentence idea (e.g., “My bin scans your trash and scores your eco-behavior”)*

- Suggested prompts to ask aloud:

*What would a bin do if it were smart?*

*Could it use AI, sensors, or apps?*

*Could it track your behavior or offer rewards?*

### *Step 2. Brainstorming – Identify a Waste Problem (10–15 minutes)*

- Divide class into groups of 4–5 students.
- Give each group access to the *Innovation Planning Template* (a Google Slide with guided questions).
- Each group discusses and answers:

*What is a waste-related problem we see in our school or community?*

*Who is affected by this problem?*

*What causes it?*

*What type of digital solution (bin, app, tracker, etc.) could help?*

- Example student answers:

*Problem: Students throw paper in the food bin*

*Solution: A bin with a camera and screen that says "Oops, wrong bin!"*

*Tech: Camera, speaker, real-time feedback display*

- Tip for teachers: Encourage students to think of where they see waste: cafeteria, hallways, school yard, events.

*Step 3. Create a Digital Poster/ Prototype (20–25 minutes)*

- Instruct each group to create a 1-slide digital poster using Canva or Google Slides.

- The slide should include:

*Name of the invention (e.g., "SmartBin 3000")*

*Visual layout (use icons, sketches, or images)*

*Slogan or tagline (e.g., "Sort Smart, Waste Less")*

*Tech tools used (e.g., "Uses motion sensors + app connection")*

*How it works (short description: "It alerts janitors when full, and tracks waste types")*

*Who it helps and why it's useful*

- Example solutions students might create:

*A smart vending bin that accepts food wrappers and gives digital credits.*

*A school-wide composting app with reminders and leaderboards..*

*A talking bin that corrects you when you sort wrong.*

Tips for teachers:

- Offer a visual example on your projector.
- Encourage Canva use for templates and icons.
- Let students draw their ideas and insert them via photo if preferred.

## *Step 4. Present & Reflect – Digital Pitch + Voting (10–15 minutes)*

- Have each group present their slide briefly (2–3 minutes). Ask them to explain:

*The problem*

*The digital solution*

*How it works and what tools it uses*

*Why it would help the school.*

- After presentations, create a Padlet or Google Form for class voting:

*Most creative*

*Best use of technology*

*Most environmentally friendly.*

- Optionally, ask students to complete this reflection: “If our invention became real, how would it change our school’s waste system?”

## Recommendation for special needs students:

- Use a simplified planning template with sentence starters and visual supports.
- Allow students to express their ideas through images, icons, or drawings instead of full text.
- Give students the option to record their explanation instead of presenting live.
- Assign clear roles in the group (e.g., designer, writer, presenter) based on each student’s strengths.
- Provide step-by-step guidance and checklists for using digital tools like Canva or Google Slides.
- Allow extra time or break the activity into two smaller sessions if needed.

## Inventory of digital tools used:

- Padlet – For warm-up or peer voting at the end of the lesson. <https://padlet.com>
- Google Slides – Used for completing the Innovation Planning Template and designing the group’s final digital poster or presentation: <https://slides.google.com>
- Canva – Digital design platform used by students to create posters or visual mock-ups of their smart waste solutions: <https://www.canva.com>
- Google Forms (optional) – Used for digital voting after presentations (e.g., most creative idea, best tech use): <https://forms.google.com>



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## Assessment:

- Teacher observation using checklist: participation in brainstorming and design, understanding of the problem and solution, and teamwork during group tasks.
- Group poster clarity and relevance: the digital design clearly presents the smart waste solution, includes visuals, and addresses a real waste problem.
- Contributions during presentations: students explain their idea, how it works, and what digital tools it uses.
- Optional student reflection sheet: “If my solution were real, how would it change waste in our school or community?”

## Module 5: Green Transportation Innovations

### Objectives:

Objectives for Green Transportation Innovations Green transportation innovations aim to create environmentally friendly transport systems that reduce emissions, improve efficiency, increase accessibility, and promote public health and social equity.

#### Core Objectives

**Reduce Transportation Emissions:** Lower greenhouse gas emissions and air pollution by supporting low-emission and zero-emission vehicles, alternative fuels, and cleaner energy sources in the transportation sector.

**Enhance Public Transportation:** Improve the reach, efficiency, and reliability of public transport to encourage its use over private vehicles, leading to reduced congestion and lower overall emissions

**Develop Sustainable Infrastructure:** Invest in EV charging stations, bike lanes, pedestrian-friendly pathways, and smart mobility platforms to facilitate and support sustainable mobility options

**Promote Active Transportation:** Encourage walking, cycling, and other non-motorized movement through better infrastructure and awareness programs, contributing to healthier communities and reduced fossil fuel use.

**Increase Transportation Equity:** Ensure that green transport systems are accessible and affordable to all, including low-income and underserved communities, to improve mobility and economic opportunities.

#### Broader Sustainability Goals

**Support Economic Growth and Job Creation:** Promote new industries and job opportunities in green transportation sectors such as EV manufacturing, infrastructure development, and public transport services

**Innovate with New Technologies:** Drive adoption of smart mobility, efficient logistics, electric and hydrogen vehicles, and synthetic fuels to continually advance transport sustainability

**Reduce Resource Consumption and Pollution:** Utilize renewable resources, optimize logistics, and support resource-efficient systems to minimize transport's environmental footprint.

**Foster Community Engagement and Awareness:** Involve communities in planning and adopting sustainable transportation; advance public understanding to maximize participation and benefits.

**Influence Policy and Regulation:** Develop supportive policies, incentives, and regulations to encourage sustainable transport practices and investment.

## Outcomes

- Significant reduction in greenhouse gas emissions (e.g., targeted 30% decrease in 5 years)
- Higher public transport ridership and lower road congestion - Established networks of EV chargers, bike lanes, and pedestrian routes - Enhanced job growth in green mobility sectors and greener economies.
- Green transportation innovations are transforming mobility and logistics to reduce environmental impact and promote sustainability.

## Key advancements include:

**1. Electric Vehicles (EVs)** - EVs eliminate tailpipe emissions and reduce air pollution. Advances in battery technology have improved range and charging times, with companies like Tesla and Volvo leading the development of electric trucks for logistics.

**2. Hydrogen Fuel Cells** - Hydrogen-powered vehicles offer zero-emission solutions, especially for heavy-duty transport. Companies like Toyota and Nikola are pioneering hydrogen fuel cell trucks, which emit only water vapor and have faster refueling times than EVs.

**3. Shared Mobility** - Bike-sharing, e-scooters, and ride-hailing services complement public transit, reducing private car use and emissions.

**4. Autonomous Vehicles (AVs)** - AVs optimize routes, improve safety, and lower operational costs. Autonomous electric trucks are being developed to enhance delivery efficiency.

**5. Biofuels** - Renewable biofuels made from organic materials like algae reduce greenhouse gas emissions compared to fossil fuels.

**6. Smart Mobility Solutions** - Technologies like real-time traffic management, multimodal platforms, and IoT-based systems optimize transport networks, reducing congestion and emissions.

**7. Cycling Infrastructure** - Cities like Copenhagen have invested in bicycle superhighways to promote cycling, reducing reliance on motorized transport and improving air quality.

These innovations collectively support the transition to sustainable transportation systems globally.

## Learning outcomes:

Learning outcomes for Green Transportation Innovations Learning outcomes for green transportation innovations focus on equipping learners with the knowledge, skills, and attitudes necessary to champion, design, and implement sustainable mobility solutions that benefit society and the environment

### Key Learning Outcomes

**Understand Environmental Impact:** Learners will be able to explain how conventional transportation contributes to climate change and how green innovations reduce greenhouse gas emissions and air pollution

**Analyze Sustainable Solutions:** Learners will assess various green transportation solutions—including electric vehicles, public transit advancements, and shared mobility—and evaluate their environmental, social, and economic benefits

**Promote Community Engagement:** Learners will develop strategies to engage communities in sustainable transport initiatives, aiming for improved public awareness, increased ridership, and greater equity in transportation access

**Practical Skills and Application – Design and Advocate Infrastructure:** Learners will gain the ability to propose, plan, and advocate for new transportation infrastructure (e.g., bike lanes, EV charging stations, pedestrian paths) in urban and regional settings.

**Implement Green Practices:** Learners will be able to recommend and implement practices (such as running successful pilot projects for e-buses, bike-sharing programs, and car-sharing systems) that encourage broader adoption of green transport technologies.

**Policy Literacy:** Learners will understand relevant policies and regulatory frameworks, and can articulate the importance of supportive policies and incentives for advancing green transportation.

## Measurable Outcomes

Ability to assess and communicate reductions in greenhouse gas emissions tied to green transport projects.

Planning and participation in public awareness campaigns that lead to a measurable increase in community knowledge and sustainable behavior.

Engagement in partnerships and collaborative projects that drive adoption and replication of green transportation models.

## Broader Impacts

**Foster Innovation Recognition:** Learners will identify and promote innovative transportation technologies and assess their potential for scaling and replication.

**Economic and Social Awareness:** Learners will recognize the role of green transportation innovation in creating jobs, supporting economic growth, and promoting social inclusion.

These learning outcomes ensure that participants are prepared not only to understand and analyze green transportation systems, but also to lead and advocate for innovation-driven sustainable mobility in real-world contexts.

**Example:** In Sweden, yesterday's dinner scraps are powering tomorrow's commutes. Through an advanced recycling system, the country transforms food waste from homes, restaurants, and supermarkets into bio-compressed natural gas (bio-CNG) - a clean, renewable fuel that runs public buses across cities. It's a brilliant loop where leftovers don't just rot - they ride.

The process begins with household food waste collection, where scraps are separated and sent to biogas plants. There, the waste undergoes anaerobic digestion — a process where microbes break it down in oxygen-free tanks, producing methane-rich gas. This biogas is then purified, compressed, and pumped into buses as fuel, reducing reliance on fossil fuels and cutting urban emissions drastically.

Swedish cities like Linköping have become models for this circular system. Buses there run almost entirely on food waste-derived bio-CNG, creating cleaner air and quieter streets. The same technology is used to fuel garbage trucks and taxis, turning waste collection into an energy source in itself.

This innovation is more than just green transport - it's a mindset. Sweden's approach shows how everyday waste can become a resource when combined with the right infrastructure and public cooperation. It connects kitchens to city streets, turning trash into travel - and leftovers into motion.

## Methodology for Green Transportation Innovations

The methodology for green transportation innovations involves a structured, multi-step approach designed to integrate sustainability, technology, policy, and community needs into

effective mobility solutions. To provide support and resources to teachers and trainers to further develop the project methodology and skills aimed at enhancing students' digital skills and eco-literacy. To facilitate the implementation of the project methodology and eco-literacy skills in educational settings, ensuring effective integration into teaching practices. To empower teachers and trainers with the necessary tools and materials to guide students in acquiring digital skills and eco-literacy competencies.

To evaluate the effectiveness of the implemented strategies and resources in enhancing students' digital skills, eco literacy, and ability to generate solutions to environmental challenges.

SABA will guide students through the exploration of eco-friendly transportation options and inspire them to design innovative solutions for sustainable mobility.

Students will examine the environmental impact of transportation systems and explore green transportation alternatives.

## Key Methodological Steps

**Define Research Questions and Objectives:** Clearly determine the sustainability challenges to address, such as reducing emissions, increasing multimodal access, or improving traffic flow.

**Design the Study or Initiative:** Select appropriate settings (e.g., campus, city, region), define stakeholder involvement, and establish targets for environmental, economic, and social outcomes.

**Literature Review and Benchmarking:** Analyze existing best practices and innovations globally to inform local adaptation (for example, electric vehicle adoption in Norway or cycling infrastructure in the Netherlands).

**Empirical Data Collection and Content Analysis:** Gather real-world data, apply coding frameworks, analyze system performance, public uptake, and technological impacts.

## Integration of Innovations

**Adopt Multimodal and Integrated Systems:** Implement unified ticketing, intermodal hubs, real-time data solutions, and seamless connections between modes (buses, trains, bikes, shuttles).

**Utilize Technology and Smart Systems:** Integrate digital platforms (IoT, AI, big data), smart mobility solutions, eco-routing, and intelligent traffic management systems to optimize flow and reduce emissions.

**Implement Policy and Regulatory Support:** Support technical advancements by enacting policies, regulations, and incentives (e.g., subsidies for EVs, emissions standards, support for bike lanes).

## Evaluation and Synthesis

Synthesize Findings and Recommendations: Develop a conceptual framework or model that connects the lessons learned, best practices, and empirical data to guide practical implementation.

Monitor, Evaluate, and Scale: Continually measure impacts on emissions, mode share, cost efficiency, and user satisfaction; iterate based on feedback and expand successful models. This comprehensive methodology ensures technological innovation is balanced with policy, inclusiveness, and real-world practicality for advancing green transportation.

## Duration: 3 hours

References:

<https://sustainabilitymag.com/top10/top-10-green-transport-solutions>

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<https://www.oecd.org/en/blogs/2025/05/what-drives-green-innovations-in-energy-transport-and-industry.html>

<https://www.sciencedirect.com/science/article/pii/S2666188825001534>

<https://www.emerald.com/jilt/article/23/1/7/1273764/Navigating-green-transport-sustainability-model>

<https://www.benthamdirect.com/content/books/9789815305548.chapter-11?crawler=true&mimetype=application%2Fpdf>

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<https://www.sustainablebusiness toolkit.com/the-future-of-sustainable-transportation/>

<https://instituteofsustainabilitystudies.com/insights/lexicon/green-technologies-innovations-opportunities-challenges/>

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<https://www.emerald.com/jilt/article/23/1/7/1273764/Navigating-green-transport-sustainability-model>, [https://www.cedefop.europa.eu/files/3069\\_en.pdf](https://www.cedefop.europa.eu/files/3069_en.pdf)

<https://ageconsearch.umn.edu/record/355432/files/GREEN%20TRANSPORTATION.pdf>

<https://sustainabilitymag.com/top10/top-10-green-transport-solutions>

<https://www.greencitytimes.com/sustainable-transport-innovations/>

<https://www.sciencedirect.com/science/article/pii/S1361920925000616>

<https://www.emerald.com/jilt/article/23/1/7/1273764/Navigating-green-transport-sustainability-model>, <https://www.oecd.org/en/blogs/2025/05/what-drives-green-innovations-in-energy-transport-and-industry.html>



## Lesson Plans

### Lesson 1

Exploration of eco-friendly transportation options

Eco-friendly transportation options are vital for reducing environmental impact and promoting sustainability.

#### Objective:

Here are key alternatives:

1. Electric Vehicles (EVs) - EVs operate on electricity, cutting greenhouse gas emissions and air pollution significantly. - They are increasingly accessible due to advancements in battery technology and charging infrastructure.
2. Public Transit - Buses, trams, subways, and trains efficiently move large numbers of people, reducing traffic congestion and carbon emissions. - Many systems now incorporate cleaner technologies like electric or hybrid vehicles.
3. Cycling and Bike-Sharing Programs - Cycling is a zero-emission mode of transport that promotes physical health. - Bike-sharing programs provide convenient access to bicycles, reducing reliance on cars for short trips.
4. Electric Scooters - Compact and battery-powered, electric scooters are ideal for short urban commutes, minimizing emissions and traffic congestion.
5. Carpooling - Sharing rides reduces the number of vehicles on the road, lowering emissions and saving costs.
6. Walking and Urban Planning - Walkable cities with dedicated pedestrian routes reduce car dependency. - Sustainable urban planning integrates green spaces and efficient public transport networks.

Adopting these options can pave the way for a cleaner, greener future.

#### Methodological guidelines:

Interactive presentations and lectures to introduce and explain key concepts in a clear, accessible manner.

Group brainstorming and collaborative creation of lesson plans

Use of AI tools (e.g., ChatGPT, Diffit, MagicSchool, Quizizz)

## What are the benefits of using electric vehicles in public transportation

Benefits of Electric Vehicles in Public Transportation Electric vehicles (EVs), particularly buses, offer numerous advantages for public transportation systems:

- 1. Reduced Emissions and Improved Air Quality** - EVs produce zero tailpipe emissions, significantly reducing greenhouse gases and harmful pollutants. This leads to cleaner urban air and fewer health issues like respiratory diseases.
- 2. Lower Operating Costs** - Electric buses have lower maintenance costs due to fewer mechanical components and reduced fuel expenses. This makes them more cost-efficient over time compared to diesel buses.
- 3. Quieter Operation** - EVs operate with minimal noise, reducing urban noise pollution and providing a more comfortable experience for passengers and residents.
- 4. Enhanced Energy Efficiency** - Electric motors are highly energy-efficient, consuming about 50% less energy than internal combustion engines, which reduces overall energy usage in transit systems.
- 5. Improved Accessibility** - Electric buses can be designed with features like ramps, wider doors, and spacious interiors to accommodate passengers with disabilities, prams, or luggage.
- 6. Reduced Dependence on Fossil Fuels** - EVs can be powered by renewable energy sources, promoting sustainability and reducing reliance on fossil fuels.

These benefits make EVs a critical component in achieving sustainable urban mobility while improving public health and environmental outcomes.

Duration: 60 min.

**Teaching materials: Presentation/Slides Outline - PowerPoint, Google Slides, or Canva, Short quiz on CO<sub>2</sub> emissions, videos.**

**Description:** About 100 participants will participate in this activity to explore eco-friendly transportation options. To communicate, learn, work and play responsibly in this environment, they need to develop a whole range of competencies that will enable them to take advantage of the benefits and opportunities of green transportation. Interactive presentations and lectures to introduce and explain key concepts in a clear, accessible manner. Group brainstorming and collaborative creation of lesson plans. Use of AI tools (e.g., ChatGPT, Diffit, MagicSchool, Quizizz) for development and assessment.

## Methodological guidelines: (step by step)

1. Interactive presentations and lectures to introduce and explain key concepts in a clear, accessible manner.
2. Group brainstorming and collaborative creation of lesson plans
3. Use of AI tools (e.g., ChatGPT, Diffit, MagicSchool, Quizizz) for development and assessment.

Recommendation for special needs students: (if any) - No

**Inventory of digital tools used:** Laptops, Desk computers, tablets, mobile phones, youtube, and web sites in references, and AI, Use of AI tools (e.g., ChatGPT, Diffit, MagicSchool, Quizizz)

**Assessment:** Adopting these options can pave the way for a cleaner, greener future. : Learners will be able to recommend and implement practices (such as running successful pilot projects for e-buses, bike-sharing programs, and car-sharing systems) that encourage broader adoption of green transport technologies.



## Lesson 2. How do biofuels compare to traditional fossil fuels in terms of environmental impact?

Biofuels and fossil fuels differ significantly in terms of environmental impact, with both advantages and challenges associated with biofuels:

### Advantages of Biofuels

1. **Lower Greenhouse Gas (GHG) Emissions:** - Biofuels generally have a smaller carbon footprint compared to fossil fuels because the plants used as feedstock absorb CO<sub>2</sub> during growth, partially offsetting emissions from combustion.
  - Second-generation biofuels (from non-food biomass) achieve greater GHG reductions than first-generation biofuels, provided no significant land-use changes occur.

2. **Reduced Air Pollutants:** - Biofuels produce fewer particulates, sulfur dioxide, and air toxics compared to fossil fuels, improving air quality.

3. **Renewable Resource:** - Unlike fossil fuels, biofuels are derived from renewable sources such as crops, waste biomass, or algae.

## Challenges of Biofuels

1. **Land-Use Change (LUC):** - Converting forests or grasslands into biofuel crop fields can release substantial CO<sub>2</sub>, potentially negating GHG benefits.

2. **Resource Intensity:** - Biofuel production can require high energy inputs (e.g., fertilizers, water), which may reduce their overall environmental benefit.

3. **Biodiversity Loss:** - Large-scale biofuel cultivation can threaten ecosystems and biodiversity.

4. **Mixed Performance:** - First-generation biofuels often fail to meet stringent GHG reduction targets, while third-generation biofuels (e.g., algae-based) are not yet viable due to high emissions during production.

**Conclusion** - While biofuels offer a renewable and potentially lower-emission alternative to fossil fuels, their environmental benefits depend on sustainable feedstock sourcing, production practices, and avoiding significant land-use changes.



## How do different feedstocks for biofuels impact their environmental footprint?

Different biofuel feedstocks have varying environmental footprints, influenced by factors such as greenhouse gas (GHG) emissions, land-use change (LUC), biodiversity impacts, and resource use. Here's a breakdown:

## 1. First-Generation Feedstocks

### Food Crops (e.g., corn, sugarcane, palm oil):

- GHG Emissions: Sugarcane ethanol achieves significant GHG reductions due to high yields and co-product credits, but other crops like corn and wheat often fall short of emission reduction targets due to intensive fertilizer use.
- Land-Use Change: Expansion of crops like palm oil and soybeans can lead to deforestation and peatland drainage, increasing emissions significantly.
- Biodiversity: Intensive farming practices and habitat loss from LUC threaten biodiversity.

## 2. Second-Generation Feedstocks

### Lignocellulosic Biomass (e.g., switchgrass, Miscanthus):

- GHG Emissions: Lower fertilizer requirements reduce nitrous oxide emissions, and perennial crops can sequester CO<sub>2</sub> in soil.
- Biodiversity: These crops may enhance biodiversity when grown on degraded lands but can harm ecosystems if cultivated as monocultures.

## 3. Third-Generation Feedstocks

**Algae and Waste Lipids:** - GHG Emissions: Algae-based biofuels have high production emissions but avoid LUC impacts. Waste lipids (e.g., used cooking oil) have the lowest carbon intensity since they repurpose existing materials.

- Resource Use: Algae require significant energy inputs for cultivation but avoid competition with food crops.

### Key Takeaways

- First-generation feedstocks often struggle with sustainability due to LUC and high resource demands.
- Second-generation feedstocks offer better environmental outcomes with fewer inputs and lower impacts on biodiversity.

- Third-generation feedstocks like waste lipids are the most sustainable, minimizing emissions and avoiding land competition.

\*

## **What are the environmental benefits of second-generation biofuels**

Second-generation biofuels offer several environmental benefits compared to first-generation biofuels and fossil fuels:

### **1. Lower Greenhouse Gas Emissions**

- They reduce GHG emissions by up to 94% compared to fossil fuels, significantly mitigating climate change impacts.

### **2. Avoidance of Food vs. Fuel Conflict**

- Derived from non-food sources like agricultural residues, woody crops, and perennial grasses, they avoid competition with food production and reduce ethical concerns.

### **3. Sustainable Land Use**

- Second-generation feedstocks can be grown on marginal or degraded lands, minimizing deforestation and preserving biodiversity.

### **4. Renewable Resource**

- These biofuels are produced from renewable materials, ensuring sustainable energy production compared to finite fossil fuels.

### **5. Improved Energy Efficiency**

- Multistage production processes enhance energy output and reduce carbon loss during biofuel creation.

These benefits make second-generation biofuels a promising solution for reducing the environmental footprint of transportation and energy sectors.

**Objective:** While biofuels offer a renewable and potentially lower-emission alternative to fossil fuels, their environmental benefits depend on sustainable feedstock sourcing, production practices, and avoiding significant land-use changes.

**Duration:** 60 min.

Methodological guidelines:

1. Interactive presentations and lectures to introduce and explain key concepts in a clear, accessible manner.
2. Group brainstorming and collaborative creation of lesson plans
3. Use of AI tools (e.g., ChatGPT, Diffit, MagicSchool, Quizizz) for development and assessment.

Teaching materials: Presentation/Slides Outline - PowerPoint, Google Slides, or Canva, Short quizzes, videos.

Description: About 100 participants will participate in this activity to find how do biofuels compare to traditional fossil fuels in terms of environmental impact.

To communicate, learn, work and play responsibly in this environment, they need to develop a whole range of competencies that will enable them to take advantage of the benefits and opportunities of green transportation.

Recommendation for special needs students: (if any) - No

Inventory of digital tools used: Laptops, Desk computers, tablets, mobile phones, youtube, and web sites in references, use of AI tools (e.g., ChatGPT, Diffit, MagicSchool, Quizizz)

Assessment: While biofuels offer a renewable and potentially lower-emission alternative to fossil fuels, their environmental benefits depend on sustainable feedstock sourcing, production practices, and avoiding significant land-use changes. Multistage production processes enhance energy output and reduce carbon loss during biofuel creation. These benefits make second-generation biofuels a promising solution for reducing the environmental footprint of transportation and energy sectors.



## Lesson 3

**Objective:**

**What are the key challenges in implementing digital twins for urban planning?**

Implementing digital twins for urban planning faces several key challenges, categorized into technical and non-technical aspects:

## Technical Challenges

### 1. Data Integration and Interoperability:

- Integrating heterogeneous systems and datasets is complex, with semantic interoperability being a major obstacle.
- Standardization issues hinder compatibility across tools and platforms.

2. **High Data Requirements:** - Accurate digital twins demand vast amounts of real-time data from IoT devices, requiring advanced sensors, computational power, and robust data management systems.

3. **Visualization and User-Friendliness:** - Smooth rendering and platform accessibility are challenging, particularly for large-scale urban models.

4. **System Complexity:** - As more systems are integrated, complexity rises exponentially, complicating implementation and maintenance.

5. **Costs:** - High initial investment for hardware, software, and cloud infrastructure remains a significant barrier.

## Non-Technical Challenges

1. **Stakeholder Collaboration:** - Effective collaboration among city planners, engineers, architects, and data scientists is essential but difficult to achieve.

2. **Regulatory and Privacy Concerns:** - Unclear regulations and privacy issues related to human-related data impede adoption.

**3. Awareness and Practical Value:** - Limited understanding among urban planners about the benefits and applications of digital twins reduces interest.

**4. Business Models:** - Uncertainty around ROI and lack of proven use cases make it hard to justify investments. Addressing these challenges requires standardized frameworks, stakeholder engagement, cost-effective solutions, and clear demonstrations of digital twins' value in urban planning.



## How are hydrogen fuel cells being integrated into public transportation?

Hydrogen fuel cells are increasingly being integrated into public transportation systems to provide zero-emission alternatives to diesel-powered vehicles.

### Key developments include:

**1. Hydrogen Buses** - Cities like London, Cologne, and Hamburg have deployed hydrogen buses, which emit only water vapor and offer quiet, clean transportation over long distances.

- Europe expand its fleet from 370 hydrogen buses on the start up to over 2000 in 2025.
- Pilot projects in North America, such as California's Zero-Emission Bus Program, test hydrogen buses under diverse conditions.

**2. Hydrogen Trains** - Hydrogen-powered trains like Alstom's Coradia iLint are operational in Germany and other parts of Europe, particularly on non-electrified tracks.

- These trains reduce reliance on diesel engines and demonstrate hydrogen's potential in rail transport.

**3. Infrastructure Development** - Cities are investing in hydrogen refueling stations and production hubs, such as Hamburg's electrolyser facility, to support large-scale adoption. Hydrogen fuel cells are transforming public transit by reducing emissions, noise pollution, and dependence on fossil fuels.



## How do hydrogen fuel cell buses compare to electric buses in terms of efficiency?

Battery-electric buses (BEBs) are generally more energy-efficient than hydrogen fuel cell buses (HFCBs). Here is a comparison:

**Energy Efficiency** - BEBs have an overall efficiency of 85-90%, meaning they retain most of the energy input for propulsion. HFCBs have an efficiency of 60-70%, as energy is lost during hydrogen production and conversion processes.

- BEBs consume less energy per kilometer compared to HFCBs, making them more efficient for urban routes.

**Range and Refueling** - HFCBs typically offer longer ranges (over 200 miles) and faster refueling times (15 minutes), which are advantageous for long-distance routes or areas with limited charging infrastructure.

- BEBs require longer charging times but are improving with advancements in battery technology.

**Seasonal Performance** - HFCBs perform better in extreme weather conditions, as BEBs show higher energy consumption variability in cold climates.

**Cost and Infrastructure** - BEBs are cheaper to operate and maintain due to simpler energy storage systems. HFCBs require specialized refueling infrastructure, which can increase costs.

While BEBs excel in energy efficiency and cost-effectiveness, HFCBs are better suited for extended range and challenging operational conditions.

## Methodological guidelines:

Exploration of eco-friendly transportation options

Eco-friendly transportation options are vital for reducing environmental impact and promoting sustainability.

Here are key alternatives:

### 1. Electric Vehicles (EVs)

- EVs operate on electricity, cutting greenhouse gas emissions and air pollution significantly.

- They are increasingly accessible due to advancements in battery technology and charging infrastructure.

## 2. Public Transit

- Buses, trams, subways, and trains efficiently move large numbers of people, reducing traffic congestion and carbon emissions.

- Many systems now incorporate cleaner technologies like electric or hybrid vehicles.

## 3. Cycling and Bike-Sharing Programs

- Cycling is a zero-emission mode of transport that promotes physical health.

- Bike-sharing programs provide convenient access to bicycles, reducing reliance on cars for short trips.

## 4. Electric Scooters

- Compact and battery-powered, electric scooters are ideal for short urban commutes, minimizing emissions and traffic congestion.

## 5. Carpooling - Sharing rides reduces the number of vehicles on the road, lowering emissions and saving costs.

## 6. Walking and Urban Planning - Walkable cities with dedicated pedestrian routes reduce car dependency.

- Sustainable urban planning integrates green spaces and efficient public transport networks.

Adopting these options can pave the way for a cleaner, greener future.



## Design innovative solutions for sustainable mobility

### Innovative Solutions for Sustainable Mobility

To design innovative solutions for sustainable mobility, several strategies and technologies can be employed:

#### Key Strategies

- **Electric Mobility:** Promote electric vehicles (EVs), e-bikes, and e-scooters, supported by expanded charging infrastructure to reduce emissions.

- **Shared Mobility:** Implement car-sharing and bike-sharing systems to optimize resource use and reduce traffic congestion.

- **Intelligent Traffic Management:** Use real-time data and smart systems to improve traffic flow, minimize congestion, and reduce emissions.
- **Mobility as a Service (MaaS):** Develop digital platforms that integrate multiple transport modes, enabling seamless trip planning and booking for users.
- **Corporate Mobility Plans:** Encourage sustainable commuting options for employees, such as EV fleets and incentive programs for greener choices.

## Innovative Technologies

- **IoT Integration:** Use connected devices to optimize transportation systems, such as autonomous shuttles or smart bicycles.
- **Blockchain Certification:** Ensure transparency in mobility systems, such as validating environmental impact or access to low-emission zones.
- **Battery-Powered Trains:** Develop electrified rail solutions to lower carbon footprints in public transport.

## Collaborative Approaches

- **Stakeholder Involvement:** Engage policymakers, businesses, researchers, and citizens in ideation sessions to co-create mobility solutions.
- **User-Centered Design:** Focus on the needs of all users, including pedestrians and cyclists, by integrating their feedback into development processes.

## Examples of Innovative Solutions

1. **Lane Patrol:** A data-driven tool to enhance cycling infrastructure safety.
2. **Nemi:** Software optimizing public transport services for efficiency and accessibility.
3. **Rideal:** A platform incentivizing sustainable travel behaviors through rewards.

These approaches collectively aim to reduce emissions, enhance accessibility, and improve urban quality of life while aligning with global sustainability goals.

Duration: 60 min.

Teaching materials: Presentation/Slides Outline - PowerPoint, Google Slides, or Canva, Short quizzes, videos.

Description: About 100 participants will participate in this activity to explore Innovative Solutions for Sustainable Mobility. To communicate, learn, work and play responsibly in this environment, they need to develop a whole range of competencies that will enable them to take advantage of the benefits and opportunities of green transportation. Interactive presentations and lectures to introduce and explain key concepts in a clear, accessible manner. Group

brainstorming and collaborative creation of lesson plans. Use of AI tools (e.g., ChatGPT, Diffit, MagicSchool, Quizizz) for development and assessment.

Recommendation for special needs students: (if any) - No

Inventory of digital tools used: Laptops, Desk computers, tablets, mobile phones, youtube, and web sites in references. Use of AI tools (e.g., ChatGPT, Diffit, MagicSchool, Quizizz)

**Assessment:** Adopting these options can pave the way for a cleaner, greener future.

**Electric Vehicles (EVs):** EVs are at the forefront, replacing internal combustion engines with electric motors to eliminate tailpipe emissions. Advances in battery technology have increased driving ranges and reduced charging times, making EVs practical for daily use. For example, Tesla's innovations have lowered costs and boosted adoption, with global EV sales projected to reach 34 million by 2030.

<https://metrobi.com/blog/benefits-of-green-transportation-to-your-business/>  
<https://www.justvoltify.com/tpost/i23f74s811-a-guide-to-green-transport-and-sustainab>

**Hydrogen Fuel Cell Vehicles:** These vehicles convert hydrogen into electricity, emitting only water. They're particularly promising for heavy transport like trucks and buses due to long ranges and quick refueling. Infrastructure is still developing, but potential is significant.

<https://www.greencitytimes.com/green-transportation-technology/>  
<https://www.fluidtruck.com/blog/key-innovations-driving-the-future-of-eco-friendly-transportation>

**Intelligent Transportation Systems (ITS):** Smart traffic lights, sensors, and connected vehicle technologies optimize traffic flow, reducing idle times and emissions. Autonomous vehicles, like those from Waymo, further enhance efficiency by optimizing routes and minimizing congestion.

<https://www.greencitytimes.com/green-transportation-technology/>  
<https://metrobi.com/blog/benefits-of-green-transportation-to-your-business/>

**Public Transit Advancements:** Electric and hybrid buses, along with electrified rail systems like the Netherlands' green-energy trains, are reducing urban emissions. In 2023, 42% of Europe's city buses were zero-emission, up from 15% in 2020.

<https://www.greenmatch.co.uk/blog/green-public-transport>

**Alternative Fuels:** Biofuels, synthetic fuels (e.g., e-methanol), and green methanol are being adopted, especially in shipping and aviation. Maersk's ECO Delivery service uses biofuel from waste oils, cutting CO<sub>2</sub> emissions by 85%, while Porsche invests in eFuels for existing engines. (<https://sustainabilitymag.com/top10/top-10-green-transport-solutions>)

**Cycling and Micro mobility:** Cities are expanding bike lanes and electric bike programs to promote zero-emission transport. Cubicycles, replacing delivery vans, save significant CO<sub>2</sub> in urban settings.

<https://thebreakthrough.org/journal/no-18-fall-2022/the-future-of-transportation-is-green>  
<https://sustainabilitymag.com/top10/top-10-green-transport-solutions>

**Sustainable Aviation and Maritime:** Electric vertical takeoff and landing aircraft (eVTOLs) and solar-powered planes like Airbus's Zephyr are emerging. Maersk's carbon-neutral methanol vessels and Norway's electric cargo ship, Yara Birkeland, are decarbonizing maritime transport.

<https://sustainabilitymag.com/top10/top-10-green-transport-solutions>  
<https://www.fluidtruck.com/blog/key-innovations-driving-the-future-of-eco-friendly-transportation>

**Innovative Materials and Design:** Lightweight materials like carbon fiber and aluminum, as seen in BMW's i3, improve energy efficiency. Additive manufacturing (3D printing) is also reducing production emissions.

<https://www.politico.eu/article/green-transportation-five-innovations-that-are-driving-efficient-vehicle-technology/>

<https://www.justvoltify.com/tpost/i23f74s811-a-guide-to-green-transport-and-sustainab>

**Route Optimization:** Systems like UPS's ORION reduce fuel use by optimizing delivery routes, saving 100 million miles annually.

<https://sustainabilitymag.com/top10/top-10-green-transport-solutions>

**Smart Infrastructure:** Solar-powered charging stations and collapsible EV chargers, like those from Duku, support clean energy integration.

<https://www.greencitytimes.com/green-transportation-technology/>

[\(https://www.openaccessgovernment.org/green-go-transport-innovation-electric-vehicles-climate-change/151521/](https://www.openaccessgovernment.org/green-go-transport-innovation-electric-vehicles-climate-change/151521/)

**Challenges:** High EV costs, limited charging infrastructure, and resistance from fossil fuel industries remain hurdles. However, supportive policies like the U.S. Inflation Reduction Act and EU's Green Deal are accelerating adoption.

<https://green.org/2024/01/30/global-efforts-to-promote-green-transportation/>

<https://www.bcg.com/publications/2024/accelerating-the-shift-to-sustainable-transport>

These innovations, backed by global investment and policy support, are paving the way for a cleaner, more efficient transportation future.

## Pre and post assessment survey

### 1. What is green public transportation?



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# Digital Eco-Leadership



- A. Transportation that is painted green
- B. Transportation that is free for students
- C. Transportation that helps reduce pollution
- D. Transportation that only runs at night

## 2. Which of the following is a green public transportation method?

- A. Diesel-powered bus
- B. Gasoline scooter
- C. Electric bus
- D. Private car

## 3. Why are electric buses better for the environment?

- A. They are faster
- B. They don't need roads
- C. They use more fuel
- D. They don't produce harmful emissions

## 4. What type of energy do green transit systems often use?

- A. Coal
- B. Nuclear
- C. Renewable energy like solar or wind
- D. Wood

## 5. What is the advantage of using trains or trams for public transport?

- a. They are expensive to ride
- b. They carry fewer people
- c. They often run on clean electricity
- d. They are always late

## 6. What is a hybrid bus?

- a. A bus that converts into a train
- b. A bus that uses both gas and electricity
- c. A bus that flies
- d. A bus that only runs on weekends

## 7. What does a bus rapid transit system typically have?

- a. Special lanes and faster routes
- b. Slow schedules
- c. Additional fees
- d. No seats

## 8. Which of the following is NOT an advantage of green public transportation?

- a. Cleaner air
- b. Less traffic
- c. Higher fuel costs
- d. Healthier communities

## 9. How can governments support green transport?

- a. By increasing fares
- b. By banning public transport
- c. By investing in electric buses and trains
- d. By encouraging greater car use

## 10. What is one big challenge to switching to green public transport?



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- a. It's too popular
- b. People forget how to drive
- c. It's expensive at first
- d. It never works in cities

## Assessment key

- 1. c
- 2. c
- 3. d
- 4. c
- 5. c
- 6. b
- 7. a
- 8. c
- 9. c
- 10. c

## Module 6: Eco-Entrepreneurship and Innovation

### Objectives:

- To introduce students to the concept of eco-entrepreneurship and the role of innovation (including AI) in solving global challenges.
- To teach students how to identify local environmental problems and generate business-oriented solutions for them.
- To develop basic skills in creating a simple business plan using a visual canvas model.
- To equip students with the skills to structure and present their ideas in a short, persuasive pitch format.

### Learning outcomes:

By the end of this module, students will be able to:

- Explain what eco-entrepreneurship is, using real-world examples (e.g., Tesla).
- Identify a local environmental problem and propose an innovative solution for it, using AI tools for brainstorming.
- Complete a simple business plan for their idea using a digital template.
- Create and deliver a short presentation (pitch) for their project.

### Methodology:

Case study analysis, interactive presentations, group brainstorming, working with digital templates, presentation creation, pitching, peer feedback, and class voting.

**Duration:** 3 hours

### References:

Social Entrepreneurship: The Case for Definition - Roger L. Martin & Sally Osberg

[https://ssir.org/articles/entry/social\\_entrepreneurship\\_the\\_case\\_for\\_definition](https://ssir.org/articles/entry/social_entrepreneurship_the_case_for_definition)

Education for Sustainable Development Goals: Learning Objectives - UNESCO

<https://unesdoc.unesco.org/ark:/48223/pf0000247444>



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How to Pitch a Brilliant Idea - Kimberly D. Elsbach

<https://hbr.org/2003/09/how-to-pitch-a-brilliant-idea>

European Entrepreneurship Competence Framework (EntreComp)

<https://publications.jrc.ec.europa.eu/repository/handle/JRC101581>

Lean Canvas - Ash Maurya

<https://leanstack.com/lean-canvas>

The European Green Deal Author

[https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal\\_en](https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en)



## Lesson Plans

### Lesson 1: The Spark: From Vision to First Step

**Objective:** To introduce students to large-scale, multi-disciplinary entrepreneurship using a comprehensive case study (Elon Musk) and a real-world first step (partner's case study), to demonstrate the role of AI in idea generation, and to guide them in identifying an environmental problem for their project.

**Duration:** 60 Minutes

#### Teaching materials:

- Projector or smartboard
- Internet connection
- The [Elon Musk Presentation](#)
- The [POSITIVE PANELS for Tenelearning module](#)
- An account for a large language model (e.g., ChatGPT, Google Gemini) for the live demonstration
- A shared Google Slides link for the collaborative activity

**Description:** This lesson takes students on a journey through the career of a visionary entrepreneur to show that innovation isn't about a single idea, but a mindset of solving problems across different industries. After this inspiring overview, the lesson transitions to a relatable example from a young entrepreneur, introduces AI as a modern tool for innovation, and concludes with a group activity where students identify their own problem to solve.

#### Methodological guidelines:

- **Step 1. Case Study: The Visionary's Journey (15 minutes)**
  - **Action:** Open and present the [Elon Musk Presentation](#)
  - **Teacher says:** "Let's start by looking at a person who doesn't just solve one problem, but sees opportunities for innovation everywhere. We're going to walk through the journey of Elon Musk."
  - **Guide to using the presentation (no deleting slides):**
    - **Slides 1-4 (Intro & Early Life):** Briefly introduce him. "He started with an interest in computers and business."
    - **Slide 5 (Tesla):** "He saw a problem with our dependency on fossil fuels. What was his solution?" (Tesla).

- **Slide 6 (SpaceX):** "He saw a risk to humanity staying on one planet. What was his solution?" (SpaceX).
- **Slides 7-11 (SolarCity, Neuralink, Boring Co., Hyperloop, OpenAI):** "He also sees problems in energy, healthcare, traffic, and even AI itself. For each problem, he creates a company to find a solution." Briefly show these slides.
- **Goal:** To establish the core theme: **"Entrepreneurs are people who consistently find problems and build solutions, no matter the industry."**
- **Step 2. Case Study: The First Step (10 minutes)**
  - **Action:** Open the [POSITIVE PANELS for Tenelearning module](#) file.
  - **Teacher says:** "But you don't have to solve 10 problems at once. Every journey starts with the first step. Let's look at a real-world example from our partner, Hugo, a young entrepreneur."
  - **Guide to using the presentation:**
    - Show **Slide 1-3.** Say: *"Hugo's startup is called Positive Panels. They create nature-friendly insulation panels."*
    - Show **Slide 4.** Say: *"He saw a problem: traditional building materials like mineral wool create a lot of CO2 emissions. His solution is carbon-negative, meaning it actually stores CO2."*
    - Show **Slide 5 (Business Model).** Say: *"He has a clear, simple plan: who his customers are, where he will sell, and why his product is better—it's sustainable and easy to use."*
  - Ask the class: *"How is Hugo's first step similar to Musk's first step with his early companies?"*
  - **Goal:** To make entrepreneurship feel accessible.
- **Step 3. AI as a Tool for Innovators (15 minutes)**
  - **Action:** Switch from the presentation to a live browser window showing an AI chatbot (like Google Gemini or ChatGPT).
  - **Teacher says:** "Today, every innovator, from Musk to Hugo to you, has a powerful assistant: Artificial Intelligence. Let's see how it can help us brainstorm."
  - Perform a live demonstration. Type a prompt into the AI chat: *"I'm a student. Give me 5 ideas for a low-cost eco-startup I could start in my school."*
- **Step 4. Group Activity – Identifying Local Problems (15 minutes)**



- **Action:** Divide students into small groups. Share the link to a blank, editable Google Slides presentation.
- **Teacher says:** "Now it's your turn. Inspired by these examples, what problems do you see around you? In your groups, add at least three text boxes to our shared slide with environmental problems you see in our school or our city."
- **Step 5. Sharing and Wrap-up (5 minutes)**
  - **Action:** Project the Google Slide with all the student-generated ideas. Each group briefly presents one problem.
  - **Teacher says:** "Now, each group must choose just one problem you feel most passionate about solving. This will be your project for the next two lessons. Please write your group name next to your chosen problem on the slide."

## Recommendation for special needs students:

- For the case studies, focus on the core images and ask simple, direct questions.
- During the group activity, allow students with writing difficulties to contribute ideas verbally while a teammate types them.
- Provide a few pre-written examples of problems on the slide to help groups that are stuck.
- Assign clear roles within the group (e.g., "idea person," "typer," "presenter").

## Inventory of digital tools used:

- **Google Slides:** For displaying presentations and for the collaborative group activity.
- **AI Chatbot (e.g., Google Gemini, ChatGPT):** For the teacher's live demonstration of brainstorming.

## Assessment:

- Teacher observation of student participation and engagement in the case study discussions.
- Evaluation of the quality and relevance of the problems identified by each group on the collaborative Google Slide.



## Lesson 2: The Blueprint: Building Your Business Plan

**Objective:** To teach students how to structure their innovative idea using a simplified, visual business plan model.

**Duration:** 60 Minutes

### Teaching materials:

- Projector or smartboard
- "[Eco-Business Canvas](#)" template, prepared in **Canva** (teacher creates and shares)
- Internet access for student research

### Description:

This lesson moves from a broad problem to a structured solution. The teacher introduces the "Eco-Business Canvas," a one-page tool designed to help students think through the most important parts of their business idea. In groups, students will fill out this canvas for their chosen environmental problem, conducting mini-research to support their ideas. The lesson concludes with a "Gallery Walk" to encourage peer feedback and learning.

### Methodological guidelines:

- **Step 1. Intro – From Idea to Plan (10 minutes)**
  - The teacher explains that every great project, from a school fair to a company like Tesla, needs a plan.
  - The teacher introduces the "[Eco-Business Canvas](#)" on the main screen. Explain that it's a simple tool to organize their thoughts on one page.
  - Briefly go over the key blocks of the canvas:
    - **Problem:** What specific issue are you solving?
    - **Solution:** What is your product or service? How does it work?
    - **Target Audience:** Who are your customers or users? (e.g., students, local cafes)
    - **Eco-Impact:** How does your solution help the planet? (e.g., reduces waste, saves energy)
    - **Unique Value Proposition:** What makes your idea special or different?
    - **Key Metrics:** How will you measure success? (e.g., number of users, kg of waste recycled)
- **Step 2. Group Work – Filling the Canvas (30 minutes)**

- The teacher shares the link to the Canva or Google Slides template with each group. Each group should make a copy for themselves.
- **Instructions for students:** "Using the problem your group chose in the last lesson, work together to fill out each block of the Eco-Business Canvas. You can use the internet and AI assistants to do some quick research. For example, search for 'who are the customers for reusable coffee cups?' or ask an AI 'how to measure the impact of a composting program?'"
- The teacher circulates around the room, offering guidance and helping groups that are stuck.
- **Step 3. Gallery Walk & Peer Feedback (20 minutes)**
  - Once the canvases are mostly complete, each group displays their work on their device.
  - One person from each group stays behind to be the "Expert" and briefly explain their plan.
  - The other students form small groups and do a "Gallery Walk," visiting each project.
  - **Peer Feedback Task:** As they visit each project, students must provide **one piece of positive and constructive feedback**. The teacher should encourage specific comments like:
    - Good feedback: *"I love your idea for an app! It's a great way to engage students. Have you thought about what rewards it could offer?"*
    - Not so good feedback: *"It's okay."*
  - Feedback can be written on small sticky notes (if in person) or in a shared digital space.

### Recommendation for special needs students:

- Provide a canvas template with sentence starters in each block (e.g., "The problem we solve is...", "Our solution helps by...").
- Allow students to use images, icons, or drawings in the canvas blocks to express their ideas.
- During the Gallery Walk, a student can have a specific role, such as being the one to read the feedback comments aloud to their group.

### Inventory of digital tools used:

- **Canva or Google Slides:** For the main activity of creating the business canvas.
- **AI Chatbot (Optional):** As a research tool for students.

## Assessment:

- Teacher observation of group collaboration and problem-solving during the activity.
- Evaluation of the completed "Eco-Business Canvas" for clarity, thoughtfulness, and completeness.
- Observation of the quality of peer feedback given during the Gallery Walk.



## Lesson 3: The Pitch: Selling Your Eco-Idea

**Objective:** To teach students how to create and deliver a short, persuasive presentation (a "pitch") about their project.

**Duration:** 60 Minutes

### Teaching materials:

- Projector or smartboard
- Internet connection
- A simple pitch presentation template in **Canva** or **Google Slides**
- **YouTube** for showing an example pitch
- A timer (on a phone or online)
- A **Google Form** for voting

### Description:

This final lesson is all about communication. Students learn the art of the "pitch"—a short, powerful presentation designed to get others excited about an idea. After watching an example, groups use a simple template to create their own "pitch deck" and then present their eco-innovation to the class in a fun, timed "competition."

### Methodological guidelines:

- **Step 1. What is a Pitch? (10 minutes)**
  - The teacher asks, "If you had only 3 minutes to convince someone to support your idea, what would you say?" Explain that this is a "pitch."
  - Show a short (1-3 minute), high-energy example of a product pitch from **YouTube**. (Search for "best product pitches" or "Shark Tank pitches for students").

- After the video, ask the class: "What made that pitch effective? Was it their energy? The story? The clear problem?"
- **Step 2. Group Work – Create Your Pitch Deck (25 minutes)**
  - The teacher shares [a link to a simple 4-slide presentation template in Canva](#).
  - **Instructions for students:** "Using your Eco-Business Canvas from the last lesson, create a short presentation. Your goal is to be clear and persuasive. Follow this structure:"
    - **Slide 1: The Problem.** (What is the big environmental problem you are solving?)
    - **Slide 2: Our Solution.** (Introduce your product/service. Show a picture or diagram.)
    - **Slide 3: Our Impact.** (Explain how your idea helps the planet and people.)
    - **Slide 4: Our Team & The Ask.** (Introduce your group and what you'd ask for next - e.g., "Support our idea!")
  - Groups work together to fill the template and practice what they are going to say.
- **Step 3. "Greenovators Pitch Competition" (20 minutes)**
  - Each group gets exactly **3 minutes** to present their pitch to the class. The teacher acts as the timekeeper.
  - After each pitch, allow 1 minute for one or two questions from the audience.
  - Encourage the class to be a supportive and engaged audience.
- **Step 4. Voting and Reflection (5 minutes)**
  - The teacher shares a link to a **Google Form** where students can vote for their favorite projects in different categories:
    - *Most Innovative Idea*
    - *Biggest Potential Eco-Impact*
    - *Most Persuasive Pitch*
  - While voting, the teacher facilitates a final round of positive feedback, asking students to share one thing they liked about another group's presentation.

### Recommendation for special needs students:

- Provide a pitch deck template with very clear prompts on each slide (e.g., "On this slide, write one sentence about the problem.").



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- Allow a student to have a non-speaking role during the presentation, such as operating the slides or holding up a visual.
- Offer the option for groups to pre-record their pitch as a short video if they have significant anxiety about public speaking.

## **Inventory of digital tools used:**

- **Canva** or **Google Slides**: For creating the pitch deck presentation.
- **YouTube**: For showing an example of a good pitch.
- **Google Forms**: For the final class voting.

## **Assessment:**

- Evaluation of the final pitch presentation based on clarity, persuasiveness, and adherence to the time limit.
- Review of the created pitch deck for structure and content.
- Observation of teamwork and participation in the final activity.

## Pre and post assessment survey

1. What is eco-technology?

- a. Technology designed to solve environmental problems in a nature-friendly way
- b. Technology used only in space research
- c. Devices that run on gasoline
- d. Entertainment-focused digital tools

2. Which of the following is an example of eco-technology?

- a. Plastic shopping bags
- b. Diesel trucks
- c. Coal-burning stove
- d. Wind turbines

3. Why should we use eco-technology?

- a. To increase production of plastic
- b. To reduce environmental problems with sustainable methods
- c. To remove all plants from cities
- d. To make energy more expensive

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6.

7. Which of the following options is a sustainable energy source?
- Coal
  - Solar energy
  - Natural gas
  - Oil
8. What is ChatGPT used for in sustainable energy classes?
- To create technical images and graphs
  - To play educational games
  - To search and organize information about green technologies
  - To make PowerPoint presentations
9. Canva is used in classes to:
- Perform renewable energy simulations
  - Create informative digital posters
  - Program energy applications
  - Translate technical texts
10. Which of the following advantages relates to the use of digital posters in class?
- They make the work more difficult to present
  - They reinforce individual and competitive work
  - They stimulate creativity and visual communication
  - They replace the need to understand the topic
11. Which of these questions is most appropriate to ask ChatGPT during an activity on sustainable energy?
- Can you do my work for me?
  - What are the most popular energy games?

- c. What is geothermal energy and how does it work?
- d. What is your name and age?
12. Which of the following best describes a smart bin?
- a. A bin made from recycled materials
  - b. A bin that sorts waste using artificial intelligence and sensors
  - c. A bin used only in factories
  - d. A bin that is painted green
13. Why are digital tools like apps and sensors important in modern waste management?
- a. They reduce the size of waste bins
  - b. They automatically burn waste
  - c. They help monitor and optimize how waste is sorted and collected
  - d. They make waste invisible
14. Which of the following is an example of a digital solution that encourages recycling through motivation or rewards?
- a. Incinerator
  - b. Smart compost bin
  - c. Reverse vending machine
  - d. Landfill tracker
15. What is green public transportation?
- a. Transportation that is painted green
  - b. Transportation that is free for students
  - c. Transportation that helps reduce pollution
  - d. Transportation that only runs at night
16. Which of the following is a green public transportation method?

- a. Diesel-powered bus
- b. Gasoline scooter
- c. Electric bus
- d. Private car

17. Why are electric buses better for the environment?

- a. They are faster
- b. They don't need roads
- c. They use more fuel
- d. They don't produce harmful emissions

18. What type of energy do green transit systems often use?

- a. Coal
- b. Nuclear
- c. Renewable energy like solar or wind
- d. Wood

19. What is the main goal of an eco-entrepreneur?

- a. To make as much money as possible.
- b. To solve an environmental problem using a business model.
- c. To work for the government.

20. What is a "pitch"?

- a. A long, detailed scientific report.
- b. A short, persuasive presentation of an idea.
- c. A type of computer program.

21. Which of these is a key part of a business plan?

- a. Knowing the problem you are solving.
- b. The color of your logo.
- c. The number of future employees.



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## Assessment key

1. a
2. d
3. b
4. –
5. –
6. –
7. b
8. c.
9. b
10. c.
11. c.
12. b
13. c
14. c
15. c
16. c
17. d
18. c
19. b
20. b
21. a



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LEADERSHIP