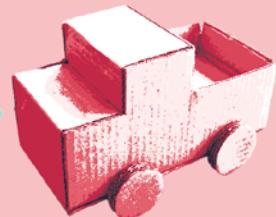
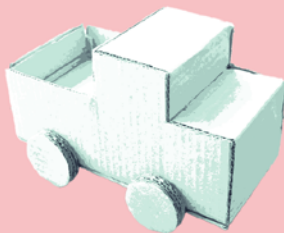
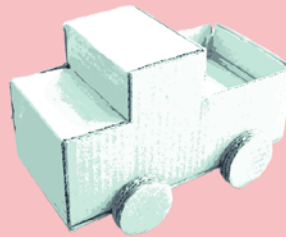




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**DON'T WAIT
TO SEE
THE LIGHT! _____**



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Kveloce



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THEORETICAL FRAMEWORK





WHAT IS PROMISED?

PROMISED (*PROM*oting twin transition through Integrated **STEAM** in bilingual Secondary **ED**ucation) is a European project funded by Erasmus+ (2023-1-ES01-KA220-SCH-000157221) that aims to transform teaching practices in secondary education by integrating:

- **STEAM education** (Science, Technology, Engineering, Arts and Mathematics),
- **CLIL** (Content and Language Integrated Learning),
- and real-world challenges related to the **twin transition**:
 - **Green transition** (sustainability, environmental awareness),
 - **Digital transition** (technological innovation, digital literacy).

The PROMISED framework, developed by Universidad de Burgos (Spain), Universidad de Granada (Spain), CFIE Burgos (Spain), Matej Bel University (Slovakia), and Howest University of Applied Sciences (Belgium), supports teachers in designing learning experiences that are interdisciplinary, plurilingual and competence-based, aligning with the priorities of the European Green Deal and the Digital Education Action Plan.

MAIN GOALS OF PROMISED

- To support the development of students' key competences** related to sustainability, digital literacy, scientific thinking and linguistic skills.
- To encourage the use of interdisciplinary, project-based and inquiry-based approaches** that make learning more engaging and meaningful.
- To promote the use of a foreign language (L2)** as a tool for learning across content areas.
- To foster teacher collaboration** through co-design, co-implementation and co-assessment of learning sequences.

HOW DOES THE PROMISED FRAMEWORK WORK?

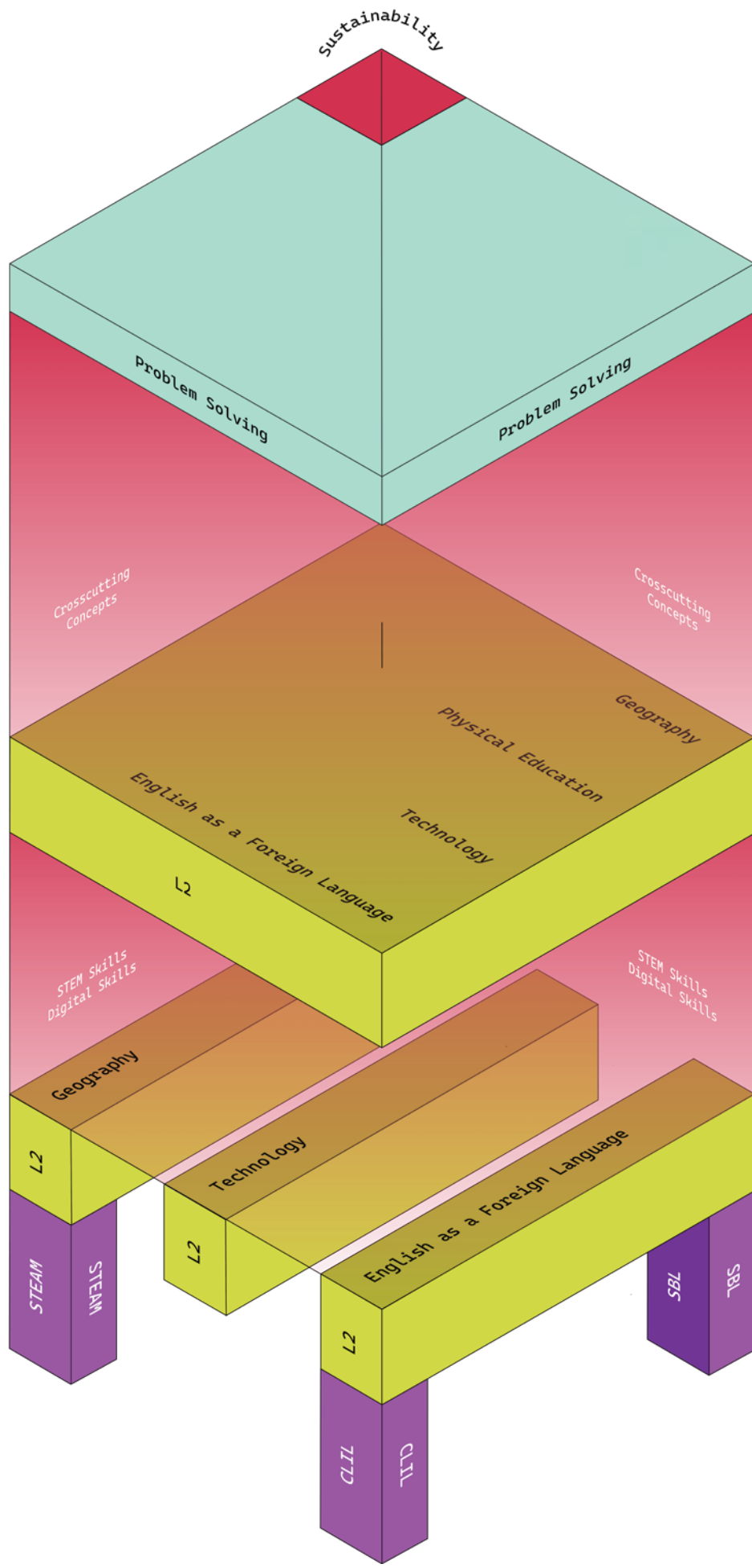
The PROMISED framework is designed to be flexible and adaptable. It offers three levels of implementation, allowing schools to progressively integrate bilingual, interdisciplinary teaching, starting from a single subject and moving towards fully collaborative, cross-curricular projects. Each level involves the use of a foreign language, as a vehicle for learning.

- Level 1: One subject + L2:** development of **STEAM and digital skills** within a single subject taught through a foreign language (L2).
- Level 2: Two subjects + L2:** connection of two or more subjects through **cross-cutting concepts**, maintaining disciplinary boundaries while fostering curricular integration.
- Level 3: Fully integrated project + L2:** holistic learning through **fully integrated projects** centred on **sustainability skills** and complex problem solving.

Level 3

Level 2

Level 1



METHODOLOGICAL FRAMEWORK

At the heart of the PROMISED framework lies a simple but powerful idea: students learn best when they work on real problems that matter. Each unit starts from a challenge that feels relevant, meaningful and connected to the world around them. These are not imaginary or abstract topics, they are based on real-life situations, such as energy poverty, pollution, or the loss of biodiversity. When students feel that what they are doing in the classroom has a purpose beyond school, they become more engaged, more curious, and more motivated to learn.

All these challenges are explored through the lens of what we call the Twin Transition, the two big changes shaping our societies today:

- the green transition, focused on sustainability and environmental responsibility, and aligned with the United Nations Sustainable Development Goals (SDGs);
- the digital transition, which brings technology, data and innovation into everyday life, and involves the development of digital skills in a functional and responsible way.

These two themes are always present in PROMISED units, helping students understand how their learning connects to the bigger picture. Whether they are designing a simple prototype, reading a story, or discussing a global issue, they are also thinking about how to make the world more sustainable and how to use technology in smart, ethical ways.

To make this kind of learning possible, PROMISED brings together three main teaching approaches that work hand in hand in every unit:

- a. STEAM: this stands for Science (Natural and Social), Technology, Engineering, the Arts and Mathematics. In our framework, we consider STEAM as an integrated educational approach that connects these subjects instead of teaching them separately. In PROMISED, students use ideas and skills

from different areas to explore real problems and find creative solutions. The goal is to help them see how knowledge works together in real life.

- b. CLIL (Content and Language Integrated Learning): CLIL means teaching subject content through a foreign language. The goal is not just to learn the language, but to use it as a tool to understand and communicate ideas. From this approach, students achieve an optimal level of cultural understanding, linguistic diversity is considered, and it is an attempt to overcome the limitations of traditional teaching by integrating the curriculum. According to Coyle et al. (2010), one of the most basic considerations is that there should be a balanced treatment among four key areas, which are: a) content, b) communication, c) cognition, and d) culture (see Figure 1). In PROMISED, students build subject knowledge while developing their communication skills through what is known as the language triptych, which includes language for learning, language of learning, and language through learning (see Figure 2).
- c. Storytelling: serving as the starting point of each unit, storytelling introduces meaningful connections through a graphic novel or comic. Instead of starting with abstract explanations, students begin by reading a visual story that presents a relatable situation connected to the central challenge. This narrative trigger helps them understand why the topic matters, creates emotional engagement and supports comprehension. The story acts as a unifying thread that connects inquiry, language development and subject content throughout the unit, giving coherence and purpose to the entire learning process.

All of these general approaches are combined with active methodologies that guide how content is explored in each unit, such as inquiry-based science education (IBSE), the teaching of social knowledge and history through a problem-oriented and action-based approach, modelling, engineering design methodology, design thinking, and

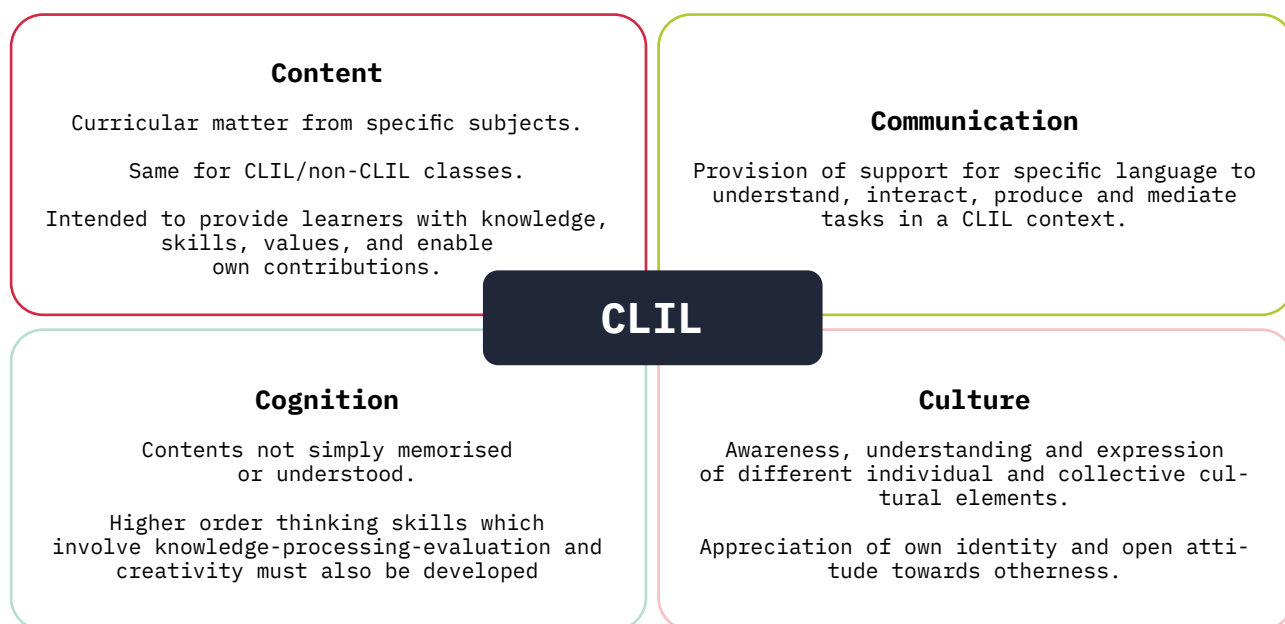


Figure 1
Foundations of CLIL and the 4Cs Model

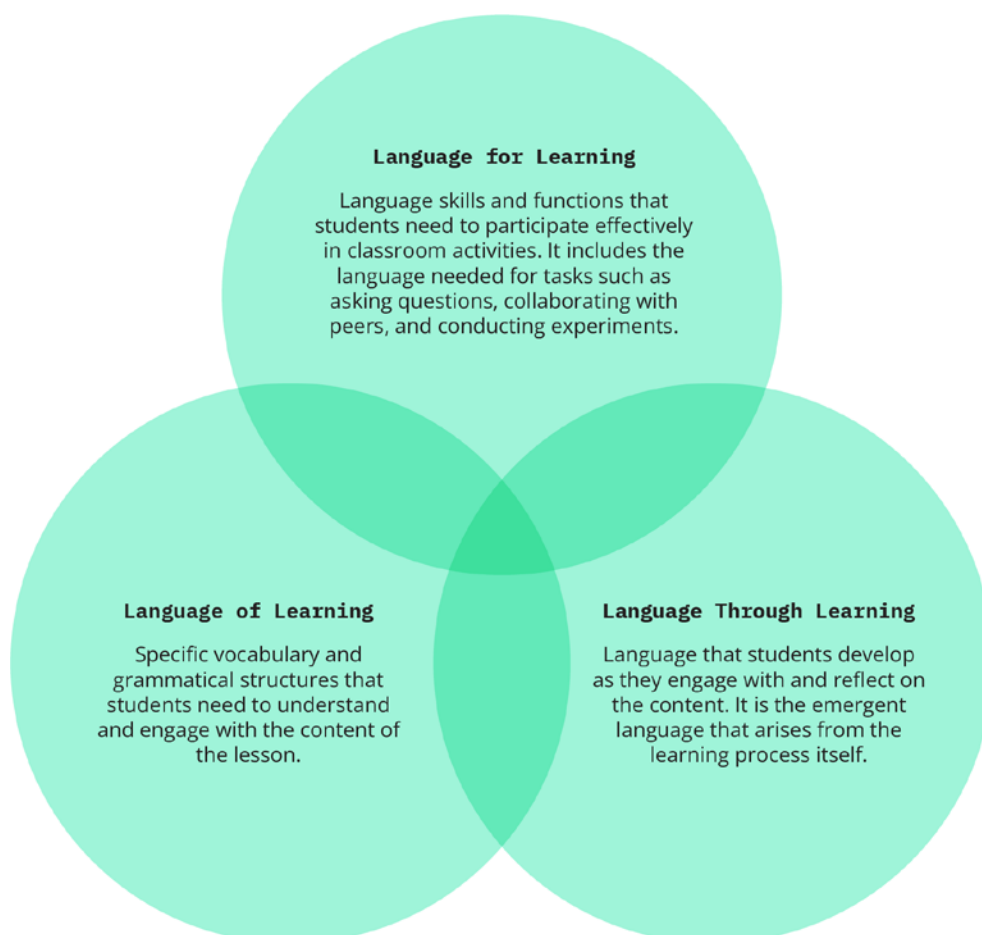


Figure 2
Language triptych: language of, for and through learning.

coding. These methodologies are integrated into the learning process to foster autonomy, engagement and interdisciplinary thinking.

In addition, PROMISED integrates a set of cross-cutting concepts that help students connect knowledge across disciplines, especially within STEAM and the social sciences. These concepts encourage learners to identify patterns, understand causes, analyse systems and think critically. The core concepts include: patterns, cause and effect, scale, proportion and quantity, systems and system models, energy-matter flows, structure and function, and stability and change.

For a full description of each methodology and the cross-cutting concepts, see PROMISED Pedagogical Framework.



CORE RECOMMENDATIONS

All the elements presented in this unit are intended as flexible guidelines, not fixed prescriptions. Teachers are not expected to follow every step exactly as written. Instead, the activities, materials and structure are designed to be adapted to the specific needs of each group, school context and teaching style. The proposals serve as a framework to inspire meaningful teaching and learning and can and should be adjusted as necessary. What truly matters is that the core principles (interdisciplinary work, active methodologies, and real-world relevance) remain central. To ensure effective integration, it is essential that all

participating teachers reach a shared agreement on objectives, key contents, and timing. Without coordination, there is a risk of teaching each subject in isolation and simply combining outcomes at the end. True curricular integration happens when all disciplines contribute in a coherent, connected way throughout the process.

This integration includes joint evaluation, which is not done separately in each subject but designed collaboratively. Teachers agree on common assessment criteria and tools, making sure that students are evaluated on what they produce and learn across the whole project – not just in one area. This allows for a more holistic understanding of student progress and reinforces the idea that the work is genuinely interdisciplinary.



LUZ AND THE FORCE OF THE LEVER





LVL 1

1. SUBJECTS



Technology



Foreign Language (L2)

2. PROJECT GOALS, LEARNING OBJECTIVES AND FINAL PROJECT

The concept of levers

- Define what a lever is and explain its role as a simple machine.
- Recognize that levers allow us to apply a small force to move a larger load.
- Identify examples of levers in everyday life and in technological systems.

Types of levers

- Distinguish between first-class, second-class, and third-class levers.
- Provide real-world examples of each type of lever (e.g., scissors, wheelbarrow, tweezers).
- Explain how the position of fulcrum, effort, and load determines the type of lever.

Lever mechanics and efficiency

- Apply the law of the lever:
 $\text{Force} \times \text{Effort Arm} = \text{Load} \times \text{Load Arm}$.
- Explain how the length of the lever arm affects the force, speed, and distance of movement.
- Demonstrate through experimentation how lever arms can be optimized for efficiency.

Design and application

- Design and build a mousetrap car that uses a lever as its driving mechanism.
- Test and compare two different prototypes within the group.
- Optimize the chosen prototype by experimenting with lever arm length, wheel size, and materials.
- Record data systematically and analyze performance results.

Collaboration and reflection

- Work collaboratively in small groups, rotating roles (designer, builder, tester, reporter).
- Communicate ideas clearly and make group decisions based on evidence from testing.
- Reflect on the design process, teamwork, and problem-solving strategies.

Sustainability and global connections

- Connect lever principles to sustainable design and energy efficiency.
- Explain how understanding simple machines contributes to innovation and sustainable solutions in everyday life.

3. SDGs

This unit is related to the following SDGs:



Discover the SDGs:



4. CROSS-CUTTING CONCEPTS

Cause and effect

Students investigate how specific design choices influence the vehicle's performance. For example, they analyse how the length of the lever arm affects the movement of the car.

Structure and function

The project emphasizes how the design of the vehicle affects its function. Students learn about

the different classes of levers and experiment with different materials, lever arms... to optimize performance. They assess how the form of their prototype influences its efficiency in movement.

Scale and proportion

A core focus of the project is understanding the working of different classes of levers.

Students explore how the relative size of the lever length affects the power and the performance of their vehicle.

5. SKILLS

5.1 STEAM SKILLS

Asking Questions and Designing Solutions

- Key Questions:
 - Why do we need levers?
 - How can levers contribute to sustainably?
 - How can we make our prototype more efficient?

Analysing, Predicting, and Interpreting Data

- Data-related tasks:
 - Measure the average distance travelled by the initial prototype.
 - Measure the performance of the vehicle after modifications.
 - Compare and analyse data to determine the impact of design changes on efficiency.

Mathematical Reasoning

- Mathematical applications:
 - Use measurements and calculations to assess travel distance.
 - Converting distances between different units
 - Apply concepts like scale and proportion when designing and modifying the vehicle.

Modelling

- Modelling Tasks:
 - Construct a physical model (the vehicle prototype) that demonstrates sustainable energy principles by using levers.

5.2 DIGITAL SKILLS

Although the project's primary focus is on physical prototyping and data analysis, noteworthy digital skills can be integrated. Some of these are provided with the activities as additional opportunities.

- Information and data literacy
 - Browsing, searching and filtering data, information and digital content
- Safety
- Problem solving

6. CLIL FRAMEWORK

In this project ***Luz and the force of the lever*** the 4 C's are introduced this way:

- **Content:** Strengthens knowledge of ***levers, motion, and engineering design***.
- **Communication:** Develops ***academic and scientific language*** skills through discussions, reports, and presentations.
- **Cognition:** Promotes ***critical thinking, data interpretation, and prototype optimization***.
- **Culture:** Encourages ***global awareness of energy issues and sustainable engineering solutions***.

Below is a **STEAM-based CLIL lesson plan** structured using the **4C's framework** for the ***Luz and the force of the lever*** project. In this project, students explore the ***principles of levers, and efficiency*** by designing and optimising a ***mousetrap car***. Through ***prototyping***, they ***analyse levers***, explore ***the law of moments, measure prototype performance, and develop problem-solving skills*** while integrating ***scientific inquiry, mathematical reasoning, and engineering principles***.

6.1. THE 4 C'S

4C	DESCRIPTION
CONTENT (Subject knowledge & skills)	• Understanding the principle of levers and their function as simple machines. • Distinguishing between first-class, second-class, and third-class levers based on the positions of fulcrum, load, and effort. • Applying the Law of Moments ($\text{Effort} \times \text{Effort Arm} = \text{Load} \times \text{Load Arm}$) to predict and measure outcomes. • Exploring key mechanical principles such as force, friction, and efficiency in the context of the mousetrap car. • Designing, building, and optimising a prototype using the engineering design process.
COGNITION (Thinking processes, problem-solving, higher-order skills)	• Applying the Law of Moments to predict the outcome of design changes. • Analysing test data to determine the cause-and-effect relationship between lever arm length and car performance. • Evaluating different designs to determine which factors (e.g., friction, lever arm) most affect efficiency. • Synthesizing knowledge by explaining how the principles of levers apply to the final prototype and real-world tools. • Developing problem-solving skills to troubleshoot issues with the prototype (e.g., "The car won't move. Why?").
COMMUNICATION (Language for learning, subject-specific vocabulary, discourse functions)	• Vocabulary development: acquiring and using terms like fulcrum, effort, load, effort arm, load arm, lever class, Law of Moments, chassis, axle, friction, optimization. • Speaking & Discussion: explaining the function of different lever types, justifying design choices based on the law of moments, and comparing prototype performance. • Writing & Presentation: summarizing test data, writing scientific conclusions, and creating a structured report on the design process. • Functional language for teamwork: negotiating roles, expressing opinions, agreeing and disagreeing, and analysing results in a group setting.

CULTURE
(Intercultural awareness, real-world application, global challenges)

- Linking to SDGs: Connecting the project to SDG 9 (Industry, Innovation & Infrastructure) by exploring how levers enable technological advances, and SDG 12 (Responsible Consumption & Production) by understanding how simple machines can optimize work with less energy.
- Exploring the historical and global impact of levers in fields from construction to medicine.
- Discussing the concept of ‘working smarter, not harder’ as a cultural value, linking back to the “Luz sees the light” narrative.
- Encouraging collaboration and scientific communication in English, which reflects a global, modern engineering environment.

6.2 THE LANGUAGE TRIPTYCH

L2 goals

These language goals align with the lesson objectives and ensure that students develop both content knowledge and language skills throughout the Luz and the force of the lever project.

Language of Learning

Goal

Students will acquire and correctly use key vocabulary and grammatical structures related to the principles of levers, mechanical advantage, and the engineering design of a mousetrap car.

Objectives

- Identify and use subject-specific vocabulary related to levers, motion, and forces.
- Understand and apply comparatives and superlatives to analyze energy efficiency (e.g., “This design is more efficient than the previous one.”).
- Use the passive voice to describe mechanical principles and test results (e.g., “The force is transferred from the mousetrap to the axle.”).
- Construct cause-and-effect sentences using conditionals to hypothesize and explain design choices (e.g., “If we increase the length of the effort arm, the car will travel a greater distance.”).
- Interpret data and measurements to compare different prototype designs.

Vocabulary list

This vocabulary can support the students throughout the project. There is a vocabulary list (with translations) available.



Lever mechanics

- **Lever mechanics:** lever, fulcrum, effort, load, effort arm, load arm, pivot point
- **Physics of levers:** law of moments, mechanical advantage, efficiency

Lever classes

- **Lever types:** first-class lever, second-class lever, third-class lever
- **Examples:** scissors, wheelbarrow, tweezers, seesaw

Prototype design

- **Design & building:** prototype, design, optimize, building
- **Car components:** chassis, axle, wheels, mousetrap, drive string
- **Process:** testing

Forces & motion

- **Forces & motion:** force, motion, friction, resistance
- **Descriptive terms:** distance, speed, gradual distribution of effort

Measurement & analysis

- **Measurement & calculation:** measure, calculate, distance, speed
- **Data analysis:** result, data, performance, average, compare, contrast, analyze

Useful grammar structures:

- **Comparisons & superlatives**
 - **A longer** lever arm requires **less** effort to move a load.
 - Our prototype was **the most efficient** because it had **the least** friction.
- **Cause & effect language**
 - **Because** we lengthened the effort arm, the car moved **further**.
 - The mousetrap spring exerts a force, **which means** the lever arm rotates and moves the car forward.
- **Conditional sentences (If-clauses)**
 - **If** we place the fulcrum closer to the load, **then** we will need less force to lift it.
 - **If** we increase the diameter of the wheels, the car **will** cover more distance with each turn of the axle.
- **Passive voice (for scientific descriptions)**
 - The force **is applied** to the effort arm of the lever.
 - The law of moments **was demonstrated** through our prototype's performance.

Example of a substitution table which can be used:

EXAMPLE – LANGUAGE STRUCTURES USING CAUSE-AND-EFFECT STRUCTURES (SUBSTITUTION TABLE)		
• The effort arm is lengthened, • The lever is designed as a first-class lever, • We experimented with different wheel sizes; • The mousetrap spring exerts a force, • The fulcrum's position was changed,	SO	• less force is needed to lift the load. • the fulcrum is located between the effort and the load. • the car's speed varied. • the lever arm rotates and moves the car forward. • a significant increase in the car's speed. • ...
	WHICH MEANS	
	AS A RESULT,	
	CONSEQUENTLY,	
	WHICH RESULTED IN	

EXAMPLE – LANGUAGE STRUCTURES USING THE PASSIVE VOICE (SUBSTITUTION TABLE)

• A small force • The fulcrum • The lever arm length • The data • The prototype	IS APPLIED	• to move a larger load. • between the effort and the load. • for efficiency. • systematically in the notebook. • on a smooth surface. • ...
	IS POSITIONED	
	IS OPTIMIZED	
	IS RECORDED	
	IS TESTED	

EXAMPLE – LANGUAGE STRUCTURES USING THE CONDITIONAL SENTENCES (IF-CLAUSES)

If you	increase the lever arm's length,	the car will travel a greater distance.
If we	reduce friction,	the car will travel further.
If we	had more time,	we would improve the design.
If the wheels had been lighter,	the car would have had less resistance.	
If we	change the material of the wheels,	the friction will change.

Language for learning

Goal

Students will use **functional language** to collaborate, analyze data, and present their findings on lever mechanics and prototype efficiency.

Objectives

- Use collaborative phrases to negotiate roles and manage tasks during group work, as described in Activity 2.3.1.
- Express and justify design choices using scientific and persuasive language.
- Use clarifying questions to deepen understanding of a group member's idea or a scientific concept.
- Present test results and interpret data us-

ing appropriate mathematical and scientific phrases.

- Offer constructive feedback to peers using polite and analytical language.

Functional phrases for group work and discussion

Brainstorming & sharing ideas

- What do you think about this design?
- I have an idea for the axle.
- Why do you think that's the best approach?

Negotiating tasks

- I can build the chassis if you can attach the lever arm.
- You will measure the distance, and I will record the results.

Building & troubleshooting

- We need to adjust the fulcrum because...
- How can we reduce the friction on the wheels?
- The car isn't moving. Let's check the string.

Testing & analysing data

- Our data shows that the average distance was...
- Let's measure the distance again to be sure.
- This prototype is 10% more efficient than the last one.

Presenting findings & reflecting

- We found that the length of the lever arm greatly affects the distance.
- In conclusion, our final design performed better because...
- If we had more time, we would improve the chassis to make it lighter.

Language through learning

Goal

Students will develop their **language skills dynamically** as they **engage with new concepts, experiment, and reflect** on their learning.

Objectives

- Reflect on **design choices and prototype performance** using scientific reasoning (e.g., "One thing we could improve is...").
- Compare and evaluate **different designs** to determine efficiency (e.g., "Why did one design perform better than another?").
- Summarize key findings using **scientific language** (e.g., "The data shows that extending the lever arm increases the gradual distribution of effort").

Strategies to encourage new language development

Reflective Writing Prompts:

- What worked well in our prototype?
- One thing we could improve is...
- I learned that energy efficiency is important because...

Comparing & evaluating results:

- Why did one design perform better than another?
- How did changing one variable affect the results?
- What patterns do we see in the data?

Example sentence structures:

- We noticed that when we changed ____, the car moved ____.
- The biggest challenge was...
- If we had more time, we would improve...

7. UDL

This unit makes extensive use of Universal Design for Learning (UDL) principles:

- Multiple means of representation: Content is presented through hands-on experiments, visual materials, group activities, readings, and digital resources, ensuring access for students with different learning preferences and abilities.
- Multiple means of action and expression: Students engage in group roles (designer, builder, tester, reporter), communicate findings, present results, and reflect in both written and oral formats.
- Multiple means of engagement: The unit includes collaborative projects, real-world problem-solving, connections to sustainable development goals (SDGs), and reflection activities to motivate and involve all students actively.

8. MAIN TEACHING METHODOLOGIES

This unit centres on active, integrated STEAM teaching strategies such as Engineering Design Methodology and Inquiry-Based Learning.

9. ASSESSMENT

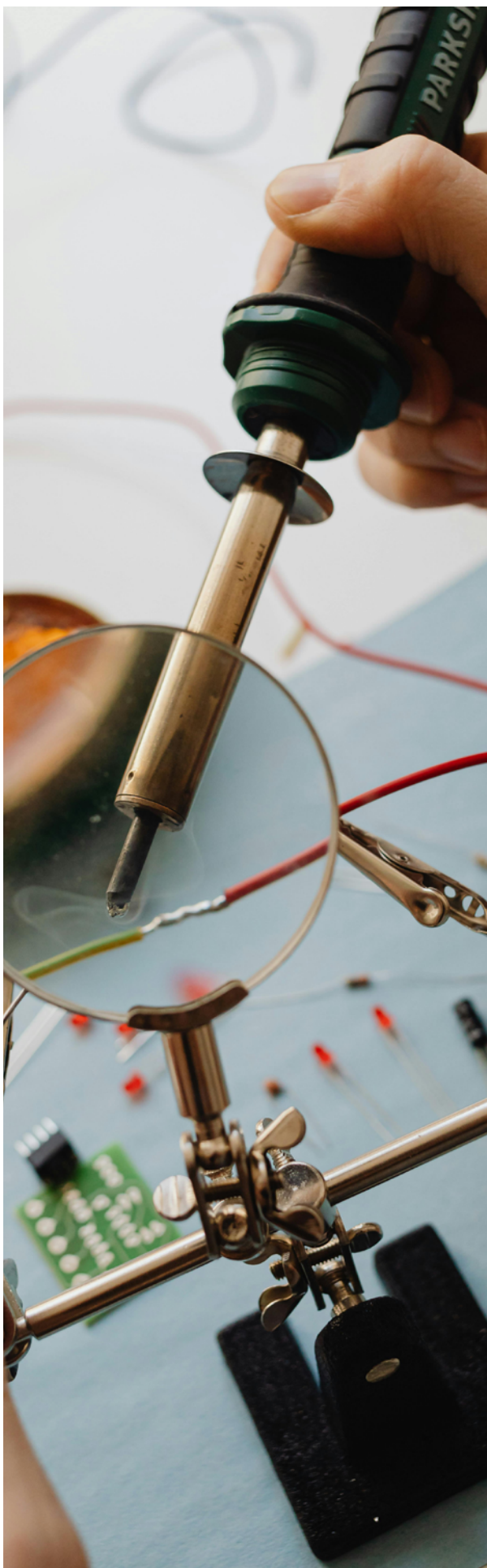
Assessment in this unit is carried out continuously and flexibly, adapting to the needs and characteristics of each group. It focuses on both the learning process and the final outcomes, evaluating content mastery, use of the target language, and the development of transversal skills. The following strategies are proposed as general recommendations and can be adapted to suit the specific context of each classroom:

- **Systematic observation:** Teachers monitor student performance throughout the project, paying attention to task completion, organization of work, participation in group activities, and the use of English in context. Observation also covers how students engage in scientific reasoning, apply the law of moments, and collaborate during activities such as lever classification, prototype building, and optimization.
- **Rubric-based evaluation of final products:** Rubrics are used to assess mousetrap car prototypes and presentations, focusing on accuracy of content, clarity of communication, creativity, feasibility of solutions, and effective use of L2 (including language accuracy, task-appropriate structures, and subject-specific vocabulary). Rubrics should be shared with students in advance (see Appendix C).
- **Self-assessment:** Students reflect on their own learning, identifying strengths and areas for improvement in collaboration, language use, and technical skills (e.g., applying lever principles, interpreting data). Reflection sheets or digital prompts may support this process (see Appendix D).
- **Peer assessment:** Students evaluate their own participation and that of their teammates using a shared rubric focused on collaboration, commitment, and accountability. This promotes responsibility, empathy, and critical thinking, while ensuring a fair distribution of tasks (see Appendix E).
- **Portfolio assessment:** Students compile a portfolio including design sketches, calculations applying the law of moments, test

data sheets, photographs of prototypes, and reflections. This provides evidence of both process and product, supporting formative and summative evaluation.

- **Short quiz on lever concepts:** A brief quiz can be used to check understanding of key principles (types of levers, law of moments, effect of lever arm length).
- **Interactive presentation with Q&A and demonstration:** Groups present their final prototype along with testing data and SDG connections. A Q&A session allows teachers and peers to assess understanding and communication skill





10. IMPLEMENTATION IN THE CLASSROOM (DESCRIPTION OF THE SEQUENCE OF ACTIVITIES)

In this project, students acquire different knowledge and skills through activities using the book *Luz sees the light*, including the ones related to L2. The activities in this project cover technology and include some content related to engineering. We provide some pre-project activities related to the book, so that in the L2 lesson teachers can introduce the book. In this document L2-teachers find different activities related to the book. Using the audiobook can help students.

Language support for the students: Let the students work with this language tool to get language support during the STEAM lessons.

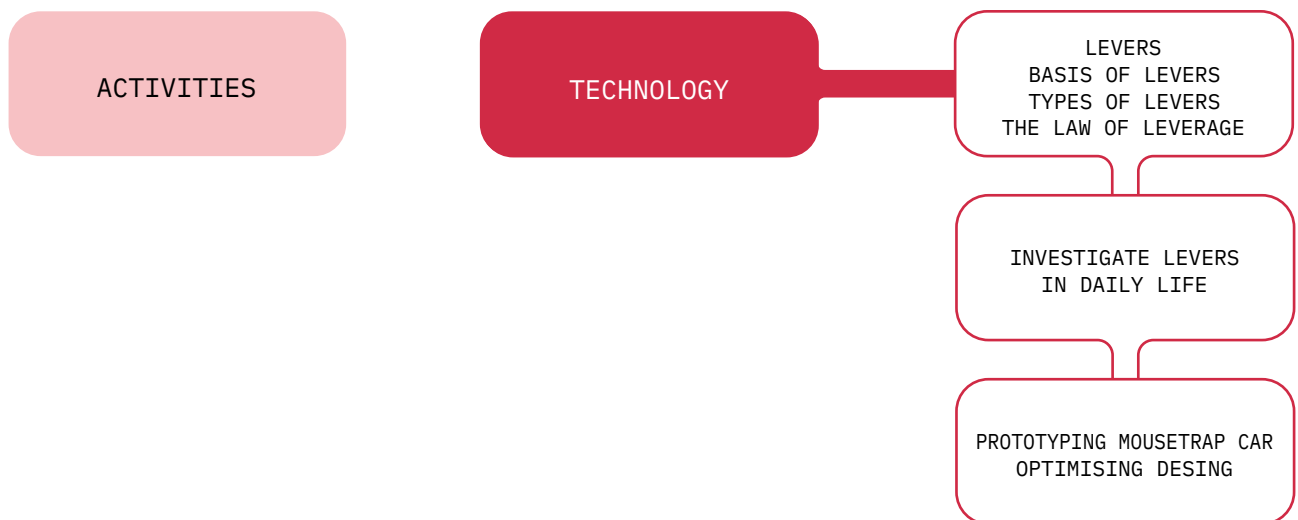
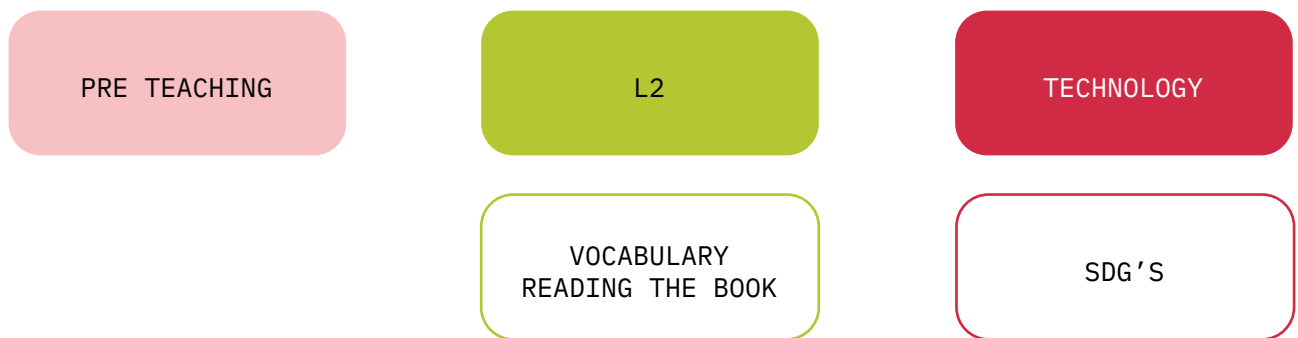


Each of the following activities is introduced by a few suggestions for the L2 teacher. Based on the specific characteristics of the class, the teacher may decide whether or not to use certain resources.



Where certain activities involves previously acquired knowledge, suggestions are provided for additional activities to introduce this knowledge and skills.

11. CONCEPT MAP



12.1 PRE-PROJECT ACTIVITIES

30-100'



INTRODUCING THE STORY

Pre-teaching of some vocabulary (L2).

Suggestion for L2 teachers

Introduce the book *Luz Sees the Light*. Use the activities provided in this document to work on the story and vocabulary before starting the science tasks based on the comic narrative, in order to establish the context of the unit



TIPS
FOR TEACHERS



YOUTUBE AUDIO
VERSION OF THE BOOK

25-40'



SDG MATCH-UP GAME

If SDGs have not yet been addressed, this specific activity (or an alternative activity) can be provided for this.

Students connect SDGs to real-life problems.

- Show **images of global problems** (e.g., plastic pollution, deforestation, poor working conditions, droughts).
- Give students **SDG cards** (with the 17 SDG icons).
- In groups, they match the **SDGs to the problems** and explain their choices.

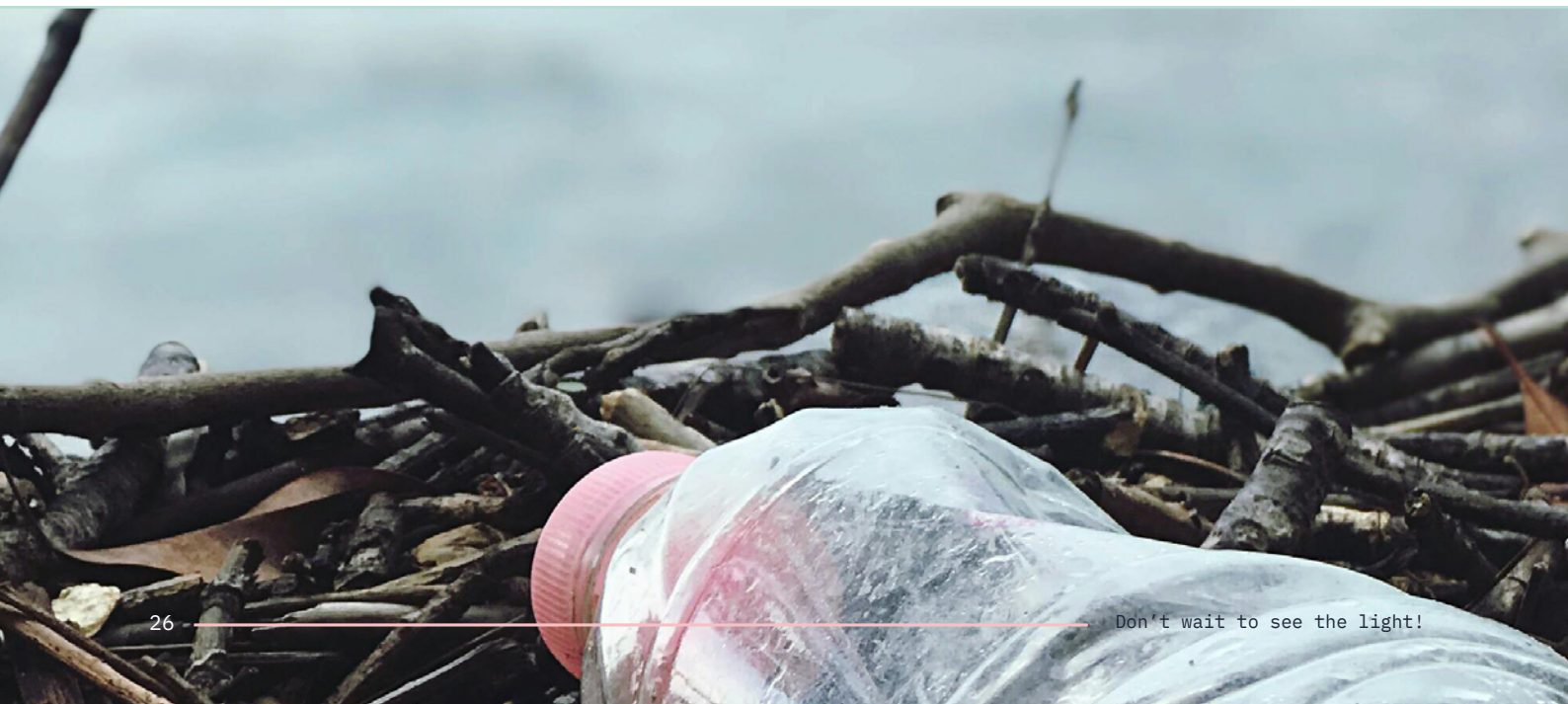
Discuss the answers as a class.



WEBSITE WITH
INFORMATION



VIDEO



ALTERNATIVE ACTIVITIES

SGD Impact walk 30-45'

Goal: Students realize how SGDs connect to their daily lives.

How?

Print or display different SDGs with short explanations around the classroom or school. Give students a worksheet with everyday activities (e.g., buying food, wearing clothes, traveling).

Students walk around, stopping at each SGD station to note how it links to their daily lives. Final discussion: Which SDGs had the biggest impact? Which were surprising?

SDG Escape Room 45-60'

Goal: Students discover the SDGs through puzzles and challenges.

- Set up 5-6 stations in the classroom, each linked to a specific SDG.
- Each station has a short challenge (e.g., a riddle, a short video with a question, a match-up game).
- Students complete the tasks and earn a code to unlock the next step.
- Final task: Match the SDGs with real-world problems and possible solutions.

Example challenges:

- SDG 6 (Clean Water & Sanitation): Solve a puzzle about how many litres of water are needed to produce a pair of jeans.
- SDG 12 (Responsible Consumption & Production): Rank products based on their environmental impact.
- SDG 8 (Decent Work & Economic Growth): Read a short case study about fair trade and decide which choices are the fairest



12.2 PROJECT ACTIVITIES

3-4HS



ACTIVITY 1

DISCOVERING THE FORCE OF LEVERS

Suggestion for L2 teachers

What? Help students describe and categorize levers and the law of motion using academic vocabulary.

Why? This reinforces scientific understanding and supports language development through classification and reasoning.

How?

- Pre-teach or revise terms from the vocabulary list (e.g., pivot point, force, motion).
- Use speaking cards to guide peer questioning and justification.
- Use the Language Support Database to model passive voice and cause-effect structures.
- Encourage phrases like:
 - “**If** we place the fulcrum closer to the load, **then** we will need less effort to lift it.”



VOCABULARY
LIST



SPEAKING
CARDS



LANGUAGE
SUPPORT
DATABASE

1.1 Introduction and link to the book and SDG's

Link Luz sees the light and levers to the idea of working smarter, not harder, sustainability and SGD's.

Introduce the challenge: Design a mousetrap car using lever principles.

“Think back to Luz Sees the Light. In the story, Luz realizes that technology and creativity can help us live in smarter, more sustainable ways. She learns that sometimes it's not about working harder, but about working smarter.

One of the ways people have been working smarter for thousands of years is by using **levers** – simple machines that make our work more efficient. With the right design, a small force can move something big!

Just like Luz, we're also thinking about sustainability. By learning how to optimize machines and use energy more efficiently, we're taking steps that connect to the **Sustainable Development Goals** – like affordable and clean energy, responsible consumption, and climate action.

Today, we'll put this into practice: we'll design and build a **mouse-trap car**. By understanding and optimising levers, we'll discover how a simple principle can power innovation – without using fuel or electricity."

SDG's

Activate prior knowledge

If pupils have not yet been taught about SDGs, you can insert one of the planned activities here (see pre-teaching).

If pupils are already familiar with SDGs, ask them the following questions:

- What are SDGs?
- What is the full name of the SDGs?
- Which SDGs do you know?
- How do you think levers can be related to SDGs?

Explanation*

"We connect this project to some of the Global Goals, also known as the United Nations Sustainable Development Goals, which aim to improve the world by 2030."

SDG 4: Quality education

The experiment offers you hands-on experience in understanding and applying physical principles. By designing and building things yourself, you learn problem-solving and collaboration skills, which are essential for quality education.

SDG 9: Industry, innovation and infrastructure

Levers are an essential part of many technological and industrial applications, from cranes to scales. By designing a tool yourself, you will experience how you can use simple principles to come up with more efficient and sustainable solutions.

SDG 12: Responsible consumption and production

By learning how simple tools work, you will understand how they can optimize physical labour with less energy consumption. This insight can be applied to designs that are less energy-intensive, such as manual tools or sustainable tools.

1.2 Problem statement and theory

"In our daily lives, we use tools to perform tasks more efficiently. Many of these tools, such as scissors, wheelbarrows, or tweezers, utilize the principle of levers to increase or transfer force. Although levers have been used for centuries, it is important to understand exactly how these tools function and how they can contribute to innovative, sustainable solutions."

TIPS FOR
TEACHERS

VARIATIONS

Teachers can choose to keep the link between the SDGs and this project for the reflection phase at the end and ask the students what link they can make with the SDGs involved after they have carried out the activities.

Use a quick demo with a ruler and eraser to show how a small force can lift a bigger object.

***Alternative:**

For class groups that are already used to this, you can let the students formulate the research question themselves.

Provide a checklist for the students



CRITERIA FOR GOOD
RESEARCH QUESTIONS

“By applying lever principles, how can we design a tool that not only works efficiently, but also offers a sustainable solution to an everyday problem?”

Guiding questions for the pupils:

- What everyday tools use levers?
- How can simple machines help us save energy?

“This question brings us to the heart of this experiment: investigating different types of levers, applying the law of moments, and developing a tool that is both functional and environmentally friendly. Through this process, we not only learn to understand the physical principles behind levers, but also how this knowledge can be applied in a practical and sustainable way in modern technology and infrastructure.”

1.3 Design question

Students write down the design question *

“How can we use the principles of lever to solve an everyday problem?”

1.4. Students formulate their hypothesis



WORKSHEET

1.5 The classes of levers

A lever is a simple tool used to transmit and increase forces/effort. It works according to the principles of the law of moments: $\text{effort} \times \text{arm} = \text{load} \times \text{arm}$. In other words, the force you apply (effort) and the distance to the pivot point (effort arm) determine how much load you can move.

The basis of levers

Each lever consists of three main parts:

- The fulcrum: The fixed spot where the lever rotates.
- The effort arm: The distance from the pivot point to where the effort is applied.
- The load arm: The distance from the pivot point to the load to be moved.

Students complete the correct terms on their worksheets.



TEACHER TOOLS (LET'S
TALK SCIENCE)

The principle of a lever makes it possible to move a heavy load with a small effort, depending on the length of the arms. The longer the effort arm in relation to the load arm, the less force/effort is required.

Types of levers

Materials: bring some levers that you can divide into these three types

There are three types of levers, depending on the position of the pivot point, the effort and the load:

Lever type 1: Pivot point between effort and load

- Examples: scissors, seesaw.
- With these levers, the pivot point is central, while the effort and load act at the ends.

Lever type 2: Load between pivot point and effort

- Examples: wheelbarrow, nutcracker.
- The load is between the pivot point and the effort. This type of lever significantly increases the power.

Lever type 3: Effort between pivot point and load

- Examples: tweezers.
- Here, the effort between the pivot point and the load is applied. This type increases speed and precision, but requires more effort.

Show students the image of types and examples of levers.

Students fill in their worksheets and note the correct class of the levers on their worksheets.

1.6 The law of moments

Suggestion: ask specific questions so that students can come to an answer themselves...

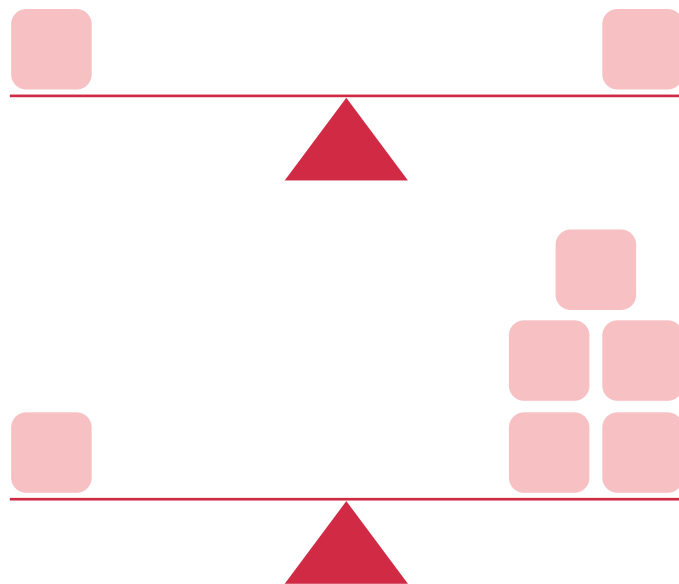
The law of moments determines whether a lever is in balance. This means that:

$$\text{Effort} \times \text{Effort Arm} = \text{Load} \times \text{Load Arm}$$

Make some examples together with the students:

Load = 1,
 Load Arm = 2 $\rightarrow 1 \times 2 = 2$
 Effort = 1,
 Effort Arm = 2 $\rightarrow 1 \times 2 = 2$
 $2 = 2$, so the lever is in
 equilibrium

Load = 1,
 Load Arm = 5 $\rightarrow 1 \times 5 = 5$
 Effort = 5,
 Effort Arm = 1 $\rightarrow 5 \times 1 = 5$
 $5 = 5$, so the lever is in
 equilibrium



Students make the exercises (worksheet).

When the students think they are done, they compare their results with the neighbor and discuss their results together before presenting them to the teacher for review.

1.7 Explicating the crosscutting concepts

Why is it important to make the crosscutting concepts explicit?
 It is a way to ensure that students can understand the connections between the different disciplines in STEAM.

Show the students this picture with a quote of Archimedes

Give me a place to stand, and a lever long enough, and I will move the world.

-Archimedes

Ask the students if they know who Archimedes was.

"Archimedes of Syracuse (Syracuse, 287 BC). – there, 212 BC.) was a Greek mathematician, physicist, engineer, inventor and astronomer.

TIPS
FOR TEACHERS

Alternative/Extension (crosscutting concepts)

This can also be moved to the end of the project during the debriefing.

More emphasis on speaking skills during this lesson?

Archimedes is widely regarded as the greatest mathematician of antiquity and one of the greatest mathematicians of all time.

In ancient times, Archimedes was much more famous for his scientific and technical achievements. In this way he laid the foundations for hydrostatics, statics and gave an explanation for the principle of the lever."

(Source: Wikipedia)

Ask the students to try to explain Archimedes' quote:

- Literally: he can move the world with a lever cf. the law of moments → technology
- Figurative: with the right knowledge and strategy, he can tackle problems anywhere → meta-principle: crosscutting concepts help us make connections between domains

Make the connection with the crosscutting concepts explicit:

Structure and function => cf. the different classes of levers

Cause and effect => heavy/light load

Scale and proportion => changing the lever arm length affects the effort

1.8 Team formation and quick research

Material: physical real-world levers that students can investigate (possibly scale models).

Groups of 3-4 students.

Each group quickly researches (or brainstorms) one real-world lever (e.g., crane, seesaw, medical tweezers...)

Presenting/sharing findings with the class.

Didactic suggestion: to ensure that every student gets to speak, give each student in a group 2 matches. Whoever takes the floor gives one match. Each student must have fired at least 1 match. This ensures that those who like to speak a lot have to think carefully when they ask to speak (only have 2 turns) and that every student is 'obliged' to speak.

Guiding questions during sharing of findings:

- What is your groups lever example?
- Name the different parts of your lever?
- How does it make work easier or more sustainable?

Use the image below to have students explain (using the right terms what they see in the image) what the link is between the crosscutting concepts and other STEAM disciplines where these concepts apply).

Crosscutting Concepts

Technology: Archimedes "he can move the world with a lever cf. the law of moments → technology"

Biology: The large, sharp incisors of a beaver are perfectly adapted to gnawing wood (structure and function)

Chemistry: reaction mechanisms in which small changes cause and effect e.g. When you mix vinegar with baking powder you get a small chemical reaction, which causes gas formation (big effect)

Geography: Hydropower and dams (scale and proportion) e.g. A small dam can block a small stream, but for a river you need a large construction.

"The same crosscutting principles that we see in levers also apply in other domains"

Expansion/Alternative (for 1.8)

Have students look up examples of levers that are used linked to different professions.

Give each group of students a profession and let them look for levers within that profession themselves (e.g. by looking up on the internet...)

Make sure that the group can also explain to the others exactly what their lever does and why it is important in the practice of that profession.



ACTIVITY 2

BUILDING, TESTING AND OPTIMISING THE MOUSETRAP CAR

TIPS
FOR TEACHERS

Use speaking cards and
role cards.

Suggestion for L2 teachers

What? Support students in using functional and scientific language during group work and prototyping.

Why? This helps learners express design choices, collaborate effectively and reflect on their process in the target language.

How?

- Revise key terms from the vocabulary list (e.g., optimize, axle, performance).
- Use speaking cards (reflection and group work) and role cards
- Refer to the Language Support Database for sentence starters and grammar tips.
- Encourage phrases like:
 - *"I think this material is more efficient because..."*
 - *"Can you explain why this shape works better?"*
 - *"Let's test this design and record the results."*



VOCABULARY
LIST



SPEAKING
CARDS



ROLE
CARDS



LANGUAGE
SUPPORT
DATABASE

2.1 Introduction

Showing an image of a mousetrap car (alternative: videos)



VIDEO EXAMPLE

To understand how levers work and how we can use them to generate movement, you will build a mousetrap car yourself. This is a small vehicle that is powered by the resilience of a mousetrap. The effort released when the mousetrap closes is transferred to the wheels via a lever, so that the car moves forward.

Ask the students "Which kind of levers do we find in a mousetrap?" (See p.31 for lever types).

2.2 The research question

Explain to the students that the question we are trying to answer by designing, building and testing the cars is the following (research question):

How do different lever arm lengths affect the speed and distance of the car?

2.3 The design process

Explain the way they are going to perform this task

- Working in groups of 4
- Students start by individually making a sketch of their own design
- Each student explains to the rest of the group the points of attention that they have taken into account in their design
- The group then chooses two designs that they will actually build.
- The students divide the tasks among themselves

Suggestion for L2 teachers

What? Support students in using functional language for sharing opinions and negotiating agreement during group work (not in the decision-making phase).

Why? This helps learners practice interactional language, build confidence in expressing agreement or disagreement, and keep the collaboration flowing in the target language.

How?

- Using the speaking cards
- Asking for someone's opinion
- Agreeing and disagreeing
- Remind students to combine scientific vocabulary (e.g., lever, force, motion, axle) with interactional phrases.
- Refer to the language support tool for sentence starters and grammar tips.
- Encourage phrases like:
 - *"What do you think about this idea?"*
 - *"I agree because the lever will give us more force."*
 - *"I see your point, but I think the motion will be smoother if we change the axle."*
 - *"That's interesting – could you explain why you believe that?"*



VOCABULARY
LIST



SPEAKING
CARDS



LANGUAGE
SUPPORT
DATABASE

Materials:

- ROADMAP.
- Sturdy cardboard, thin wooden boards, or plastic sheet (for the base).
- Scissors or cutter (teacher supervision required).
- Strong tape or glue.
- Wooden sticks, skewers, or thin metal rods (for axles).
- Cardboard circles, plastic bottle caps, or CDs (for wheels).
- Straws or small tubes (to guide the axles).
- 2 mousetraps per group (prepared safely by the teacher).
- Wooden stick or slat to extend the mousetrap arm.
- Strong string, nylon thread, or fishing line.
- Measuring tape or ruler.
- Stopwatch.



ROADMAP

Building of the cars

- Students following the roadmap provided by the teacher
- Teacher guidelines for step-by-step support:
 - **Step 1 – Building the base**
Look for: Stable frames where wheels spin freely. Students might struggle with alignment. Encourage them to test axle movement before attaching the mousetrap.
 - **Step 2 – Attaching the mousetrap**
Key point: The trap must be securely fixed to avoid shifting. If students struggle, suggest additional tape or reinforcement materials.
 - **Step 3 – Extending the lever**
Expected insight: Longer arms generally produce smoother effort transfer and allow the car to travel farther. However, arms that are too long may break or reduce stability.
 - **Step 4 – Installing the drive system**
Guide students to wind the string carefully. If the car doesn't move, check that the string unwinds in the correct direction.
 - **Step 5 – Testing and optimising**
Encourage students to:
 - Test systematically (change one variable at a time).
 - Record distances carefully.
 - Compare Car 1 and Car 2 results to choose the better prototype.

2.4 Reflection

Suggestion for L2 teachers

What? Support students in explaining design improvements and presenting results.

Why? This fosters confidence in using English to describe technical changes and interpret data.

How?

- Reuse terms from the vocabulary list (e.g., resistance, optimization).
- Use speaking cards for presenting and reflecting.
- Use the Language Support Database to scaffold comparative and analytical language.
- Encourage phrases like:
 - *"Our modified car travelled 20% further."*
 - *"Compared to the first prototype, this one is more stable."*



VOCABULARY
LIST



SPEAKING
CARDS



LANGUAGE
SUPPORT
DATABASE

Group reflection

You can choose to have the group reflection take place in class or in the groups. The reflection in groups (instead of in class) gives the individual students more opportunities to speak...

Examples of possible answers:

- Lever principle applied: Longer lever arm increased distance travelled.
- Difference between Car 1 and Car 2: Car 1 had larger wheels, which improved stability.
- Link to SDGs: Using simple machines efficiently shows how technology can reduce energy needs.

Individual Reflection

Examples of possible answers:

- Learned about levers: Small input effort can create large output effort.
- Learned about teamwork: Everyone's role contributed to success.
- Improvement: Use lighter wheels to reduce friction.

2.5 Answering the research question explicitly

Repeat the design question and ask the students for an answer.

How do different lever arm lengths affect the speed and distance of the car?

Expected student insight:

- **Longer lever arms** transfer the effort more gradually.
 - Result: smoother motion, slower start, but car travels a **greater distance**.
- **Shorter lever arms** release effort more quickly.
 - Result: faster start (more speed at the beginning), but the car usually travels a **shorter distance**.

Possible good student answers:

- *"With a longer arm, the car goes farther but starts slower."*
- *"With a shorter arm, the car starts faster but doesn't travel as far."*

ALTERNATIVE ACTIVITIES

You can give the students more freedom in designing their mousetrap car and provide multiple materials during the design process.

Suggestion: Provide materials in shared “supply stations.” Each group selects what they need – not every group uses every item.

Materials checklist can be used to help the groups to choose.



MATERIAL
CHECKLIST

Core components (mandatory basics)

- 2 mousetraps per group (pre-checked for safety).
- Cardboard sheets (various thicknesses).
- Wooden sticks (BBQ skewers, dowels, popsicle sticks).
- String, fishing line, or strong thread.
- Tape (masking tape, duct tape, double-sided tape).
- Glue (hot glue gun with supervision, wood glue, or eco-friendly craft glue).

Optional frame & chassis materials

- Foamboard.
- Lightweight wood (balsa, thin plywood).
- Plastic sheets (reused packaging, cut bottles, yogurt lids).
- Metal wire (coat hangers, paperclips).

Wheels & axles

- CDs/DVDs (with rubberbands around as “tires”).
- Plastic bottle caps.
- Cardboard circles (pre-cut or student-made).
- Toy wheels (LEGO, K’NEX, etc.).
- Wooden dowels, skewers, straws, chopsticks (for axles).
- Drinking straws or pen tubes (as axle housings).

Lever arm extensions

- Wooden rulers.

- Chopsticks.
- Paint stir sticks.
- Plastic strips (cut from bottles).
- Strong cardboard strips.
- Fasteners & reinforcements.

Rubber bands (various sizes)

- Paperclips.
- Clothespins.
- Binder clips.
- Screws, small nails, thumbtacks (optional, only under supervision).

Measuring & testing tools

- Rulers and measuring tape.
- Stopwatch.
- Scale (optional, for weight comparisons).

Extra materials for creativity / sustainability

- Recycled materials box: cardboard tubes, egg cartons, cereal boxes.
- Old CDs, DVDs, or jar lids for wheels.
- String from reused packaging.
- Fabric scraps (to wrap axles or wheels for friction).

Safety equipment

- Safety goggles (for when mousetraps are released).
- Gloves (optional, for handling wood/metal).
- First aid kit nearby.

Option for learners who may struggle with following the written plan:

- Provide pictograms and visual icons for each step.
- Add images illustrating the building process of the mousetrap car.
- Offer short videos demonstrating each stage of construction

Suggestion for L2 teachers

- Role cards
- Speaking cards:
 - Reflecting

PROJECT ASSESSMENT



20-60'

Content (see rubric appendices)

Possible evaluation methods:

- Individual reflection report:
 - Students write a personal report reflecting on their learning process.
 - Short quiz on lever concepts (types, law of moments, effect of lever arm length)
- Group reflection & peer feedback session:
 - During and after the prototyping and testing phases, students participate in guided group discussions where they reflect on their design choices, collaboration, and learning. Peers can provide constructive feedback using a simplified version of the rubric.
- Teacher observation & checklist:
 - Throughout the project, the teacher uses a structured checklist to observe and record group interactions, effective application of learned concepts, problem-solving strategies, and overall engagement during key phases such as brainstorming, prototyping, and the reflection activity.

TIPS FOR TEACHERS

The criteria in the provided rubrics can be used formatively for feedback during the process or summatively for final assessment.

Assessment: see rubrics appendices.

Language (see rubric appendices)



LUZ AND THE FUTURE IN MOTION



LVL 2





2.1

LUZ IN MOTION

1. SUBJECTS



Science



Technology



L2

2. PROJECT GOALS, LEARNING OBJECTIVES AND FINAL PROJECT

The concept of energy

- Define energy and explain its role in everyday life.
- Recognize that energy is the capacity to cause change.
- Identify examples of energy in natural and human-made systems

Forms of energy

- List and describe different forms of energy, such as kinetic, potential (gravitational and elastic), thermal, chemical, electrical, and light energy.
- Distinguish between kinetic and potential energy with examples.
- Demonstrate how different forms of energy are observed in real-world situations.

Energy conversions

- Explain that energy can change from one form to another (e.g., chemical energy to thermal energy).
- Illustrate common energy conversions in everyday devices (e.g., a toaster converts electrical energy to thermal energy).

Energy transfer

- Explaining that energy can transfer from one system to another (e.g. the transfer of kinetic energy from one system to another, foot against ball, ball breaking a window,...)

Conservation of energy

- State the principle of conservation of energy: energy in an isolated system cannot be created or destroyed, only transformed or transferred.
- Apply the concept of energy conservation to simple systems, such as a swinging pendulum.
- Explain how the conservation of energy relates to sustainable energy use in the environment

3. SDGs

This unit is related to the following SDGs:



4. CROSSCUTTING CONCEPTS

Systems and system models

Students analyse their prototype vehicle as a system, identifying key components such as the energy source (a wound-up rubber band or other elastic material), the structure of the car, and frictional forces. They explore how changes in one part of the system (e.g., increasing tension in the rubber band) impact the overall movement of the vehicle.

Cause and effect

Students investigate how specific design choices influence the vehicle's performance. For example, they analyse how increasing potential energy (by stretching the rubber band more) results in greater kinetic energy and a longer travel distance.

They also explore how reducing friction improves efficiency, linking this to real-world energy conservation strategies.

Structure and function

The project emphasizes how the design of the vehicle affects its function. Students experiment with different materials, wheel sizes, and axle designs to optimize performance. They assess how the form of their prototype influences its efficiency in energy conversion and movement.

Stability and change

Students explore how energy is conserved and transformed in different systems, including their vehicle and real-world renewable energy applications (e.g., solar panels and wind turbines). They analyse how small design modifications can lead to significant improvements in energy efficiency, mirroring real-world innovations in sustainable technology.

Energy and matter

A core focus of the project is understanding different forms of energy (potential, kinetic, thermal) and how energy is converted and transferred. Students explore the law of conservation of energy by optimising their vehicle's efficiency and comparing it to sustainable energy systems such as solar panels and wind turbines.

Patterns

Students identify patterns in energy conversion and vehicle performance by testing and refining their prototypes. They analyse data on how different variables (e.g., wheel size, rubber band tension, surface friction) affect movement distance, allowing them to recognize trends and make data-driven improvements.

Scale and proportion

Students explore how the relative size of different components affects the performance of their vehicle. For example, they examine how adjusting the wheel size or the length of the rubber band influences speed and distance travelled. By optimising these proportions, they gain a deeper understanding of how design scaling impacts energy transfer and motion efficiency.

5. SKILLS

5.1 STEAM SKILLS

Asking Questions and Designing Solutions

- Key Questions:
 - Why do we need energy?
 - How can we use energy more sustainably?
 - How can we build a prototype of a sustainable car that doesn't rely on batteries or electricity?

Analysing, Predicting, and Interpreting Data

- Data-related tasks:
 - Measure the average distance travelled by the initial prototype.
 - Measure the performance of the vehicle after modifications.
 - Compare and analyse data to determine the impact of design changes on efficiency.

Mathematical Reasoning

- Mathematical applications:
 - Use measurements and calculations to assess travel distance.
 - Converting distances between different units
 - Apply concepts like scale and proportion when designing and modifying the vehicle.

Modelling

- Modelling Tasks:
 - Construct a physical model (the vehicle prototype) that demonstrates sustainable energy principles.
 - Use the prototype as a model to simulate energy conversion (from elastic potential to kinetic energy) and energy loss (through friction).

5.2 DIGITAL SKILLS

Although the project's primary focus is on physical prototyping, energy understanding and data analysis, noteworthy digital skills can be integrated. Some of these are provided with the activities as additional opportunities.

- Information and data literacy
 - Browsing, searching and filtering data, information and digital content
- Safety
- Problem solving

6. CLIL FRAMEWORK

In this project ***Energy – Luz in motion*** the 4 C's are introduced this way:

- **Content:** Strengthens knowledge of ***energy, motion, and engineering design.***
- **Communication:** Develops ***academic and scientific language skills*** through discussions, reports, and presentations.
- **Cognition:** Promotes ***critical thinking, data interpretation, and prototype optimization.***
- **Culture:** Encourages ***global awareness of energy issues and sustainable engineering solutions.***

Below is a ***STEAM-based CLIL lesson plan*** structured using the ***4C's framework*** for the ***Luz in Motion (Energy) Project***. In this project, students explore the ***principles of energy transfer, motion, and efficiency*** by designing and optimising a ***rubber-band-powered vehicle***. Through hands-on experimentation, they ***analyze energy transformations, measure prototype performance, and develop problem-solving skills*** while integrating ***scientific inquiry, mathematical reasoning, and engineering principles.***



6.1. THE 4 C'S

4C	DESCRIPTION
CONTENT (Subject knowledge & skills)	• Understanding forms of energy (kinetic, potential, thermal, chemical, electrical, light); • Exploring energy transfer and transformation (energy input, energy output, energy loss); • Investigating Newton's Laws of Motion and their impact on prototype movement; • Designing, building, and optimising a rubber-band-powered prototype car; • Conducting experiments to measure speed, distance, and efficiency; • Analysing data to determine how different variables affect energy efficiency.
COGNITION (Thinking processes, problem-solving, higher-order skills)	• Applying scientific principles to design and test energy-efficient vehicles; • Using mathematical calculations to analyze prototype performance; • Evaluating different designs to determine which factors affect energy efficiency; • Developing problem-solving skills (e.g., How can we make the prototype travel further with the same energy input?); • Interpreting experimental data to improve future prototypes; • Synthesizing learning by presenting findings and explaining real-world applications of energy principles.
COMMUNICATION (Language for learning, subject-specific vocabulary, discourse functions)	• Vocabulary development: energy transfer, velocity, force, friction, acceleration, efficiency, aerodynamics, torque, momentum, resistance; • Speaking & discussion: explaining energy conversions, justifying design choices, comparing energy efficiency; • Writing & presentation: summarizing data, writing scientific conclusions, creating a structured report; • Functional language for teamwork: assigning roles ("You will measure speed, and I will record the results."), hypothesizing ("If we reduce friction, the car will move faster."), analysing results ("The average distance was... because...").

CULTURE (Intercultural awareness, real-world application, global challenges)	• Linking to SDGs: Connecting the project to Sustainable Development Goals (SDG 7: Affordable & Clean Energy, SDG 9: Industry, Innovation & Infrastructure, SDG 12: Responsible Consumption & Production); • Exploring the impact of energy efficiency in real-world scenarios (e.g., transport, sustainability, technological innovations); • Discussing global energy challenges (e.g., renewable energy sources vs. fossil fuels, energy poverty, sustainable mobility); • Encouraging teamwork & international collaboration by applying scientific communication skills in an English-medium setting; • Applying design thinking & engineering principles that connect science to industry innovations.
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6.2 THE LANGUAGE TRIPTYCH

L2 goals

These **language goals** align with the **lesson objectives** and ensure that students **develop both content knowledge and language skills** throughout the **Energy – Luz in Motion project**.

Language of learning

Goal

Students will acquire and correctly use **key vocabulary and grammatical structures** related to **energy forms, energy conversions, forces, motion, and efficiency in prototype design**.

Students will also use **appropriate grammatical structures to explain, compare, and analyze** energy and motion concepts.

Objectives

- Identify and use **subject-specific vocabulary** related to energy, motion, and forces.
- Understand and apply **comparatives and superlatives** to analyze energy efficiency (e.g., “*This design is more energy-efficient than the previous one.*”).
- Use **passive voice** to describe energy conversions (e.g., “*Energy is transferred from the rubber band to the wheels.*”).
- Construct **cause-and-effect sentences** using conditionals (e.g., “*If we reduce friction, the car will travel further.*”).
- Interpret **data and measurements** to compare different prototype designs.

Vocabulary list

This vocabulary can support the students throughout the project. There is a vocabulary list (with translations) available.



Energy & Physics Concepts

- **Forms of Energy:** kinetic, potential, thermal, chemical, electrical, light energy
- **Energy Conversions:** energy transformation, energy transfer, input energy, output energy
- **Energy Sources:** renewable energy, non-renewable energy, fossil fuels, solar energy, wind energy
- **Energy Conservation:** law of conservation of energy, efficiency, energy loss, heat dissipation

Forces & Motion

- **Physics of Motion:** force, friction, acceleration, momentum, resistance
- **Prototype Design:** axle, wheels, chassis, sub-systems, function triangle, aerodynamics

Measurement & Data Analysis

- **Measurement Terms:** distance, speed, velocity, mass, force, resistance
- **Units of Measurement:** joule (J), newton (N), metre per second (m/s), watt (W)
- **Data Interpretation:** average, percentage, variance, trend analysis

Useful grammar structures:

- **Comparisons & Superlatives**
 - A larger rubber band stores **more potential energy** than a smaller one.
 - Our car was **the fastest** because it had **the least friction**.
- **Cause & Effect Language**
 - Because we increased the wheel size, the car moved further.
 - Since friction was reduced, the car's efficiency improved.
- **Conditional Sentences (If-clauses)**
 - If we change the material of the wheels, then...
 - If we increase the axle's width, the stability will...

Passive Voice (for Scientific Descriptions)

- Energy **is converted** from potential to kinetic energy.
- The results **were recorded** in the data table.

Language for learning

Goal

Students will use **functional language** to collaborate, discuss, analyze, and present their findings on energy transfer and prototype efficiency.

Objectives

- Use **clarification and questioning strategies** to deepen understanding (e.g., "How does the rubber band store energy?").
- Express opinions and justify reasoning in **group discussions** (e.g., "I think this design is more effective because...").
- Use **formal scientific language** to describe and compare prototype efficiency (e.g., "Our prototype travelled 20% further than the previous version.>").
- Apply **mathematical language** to analyze test results (e.g., "The average speed of our car was 1.5 m/s.>").

Functional phrases for group work and discussion

- **Asking for clarification & discussing ideas**
 - Can you explain how energy is converted in our prototype?
 - Why do you think this design is more efficient?
 - What happens if we increase the tension of the rubber band?
- **Groupwork & experimenting language**
 - Let's test our car and record the results.
 - We need to adjust the wheels because...
 - How can we improve the design to reduce friction?
- **Presenting results & analysing data**
 - Our data shows that the average distance travelled was...
 - Comparing our prototype to others, we found that...
 - The percentage difference between our design and the winning car is...

Language through learning

Goal

Students will develop their **language skills dynamically** as they **engage with new concepts, experiment, and reflect** on their learning.

Objectives

- Reflect on **design choices** and **prototype performance** using scientific reasoning (e.g., “One thing we could improve is...”).
- Compare and evaluate **different designs** to determine efficiency (e.g., “Why did one design perform better than another?”).
- Summarize key findings using **scientific and mathematical language** (e.g., “The data shows that reducing friction increased efficiency by 15%.”).

Strategies to encourage new language development

- **Reflective Writing Prompts:**
 - What worked well in our prototype?
 - One thing we could improve is...
 - I learned that energy efficiency is important because...
- **Comparing & evaluating results:**
 - Why did one design perform better than another?
 - How did changing one variable affect the results?
 - What patterns do we see in the data?
- **Example sentence structures:**
 - We noticed that when we changed ____, the car moved ____.
 - The biggest challenge was...
 - If we had more time, we would improve...

7. UDL

This unit makes extensive use of Universal Design for Learning (UDL) principles:

- Multiple means of representation: Students encounter content in various forms: readings, hands-on prototyping, data analysis, group discussions, and digital resources.
- Multiple means of action and expression: Learners engage in experiments, group roles, design and testing of models, formal presentations, data reporting, and written reflection.

- Multiple means of engagement: The unit uses collaborative projects, connections to Sustainable Development Goals (SDGs), peer and group feedback, and reflective activities to maintain motivation and reach diverse learners.

8. MAIN TEACHING METHODOLOGIES

This unit centres on active, integrated STEAM teaching strategies such as Inquiry-Based Learning and Modelling.

9. UDL

Assessment in this unit is carried out continuously and flexibly, adapting to the needs and characteristics of each group. It focuses on both the learning process and the final outcomes, evaluating content mastery, use of the target language, and the development of transversal skills. The following strategies are proposed as general recommendations and can be adapted to suit the specific context of each classroom:

- **Systematic observation:** Teachers monitor student performance throughout the project, paying attention to task completion, organisation of work, participation in group activities, and the use of English in context. Observation also covers how students engage in scientific reasoning, prototype design, and collaborative problem-solving during activities such as building and testing rubber-band cars, analysing energy conversions, and optimising designs.
- **Rubric-based evaluation of final products:** Rubrics are used to assess prototypes and presentations, focusing on accuracy of content, clarity of communication, creativity, feasibility of solutions, and effective use of L2 (including language accuracy, task-appropriate structures, and subject-specific vocabulary). Rubrics should be shared with students in advance (see Appendix C).



- **Self-assessment:** Students reflect on their own learning, identifying strengths and areas for improvement in collaboration, language use, and technical skills (e.g., applying energy concepts, interpreting data). Reflection sheets or digital prompts may support this process (see Appendix D).
- **Peer assessment:** Students evaluate their own participation and that of their teammates using a shared rubric focused on collaboration, commitment, and accountability. This promotes responsibility, empathy, and critical thinking, while ensuring a fair distribution of tasks (see Appendix E).
- **Portfolio assessment:** Students compile a portfolio including design sketches, function triangle, test data sheets, photographs of prototypes, and reflections. This provides evidence of both process and product, supporting formative and summative evaluation.
- **Interactive presentation with Q&A and demonstration:** Groups present their final prototype along with testing data and SDG connections. A Q&A session allows teachers and peers to assess understanding and communication skills.

10. IMPLEMENTATION IN THE CLASSROOM (DESCRIPTION OF THE SEQUENCE OF ACTIVITIES)

In this project, students acquire different knowledge and skills through activities using the book *Luz sees the light*, including the ones related to L2. The activities in this project cover technology and natural sciences and include some content related to mathematics.

We provide some pre-project activities related to the book, so that in the L2 lesson teachers can introduce the book. In this document L2-teachers find different activities related to the book. Using the audiobook can help students.



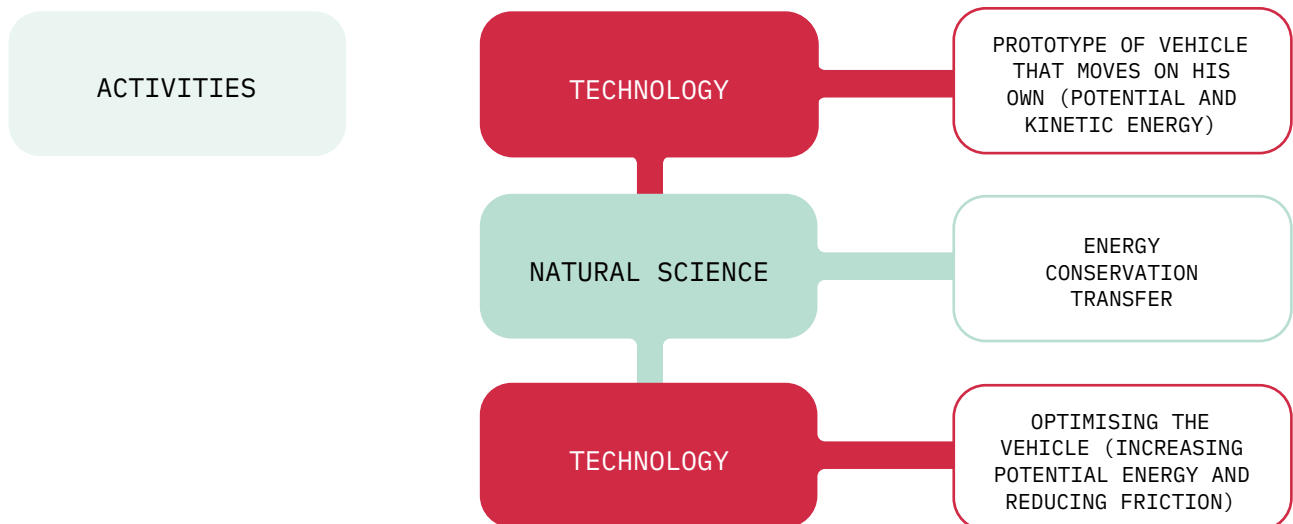
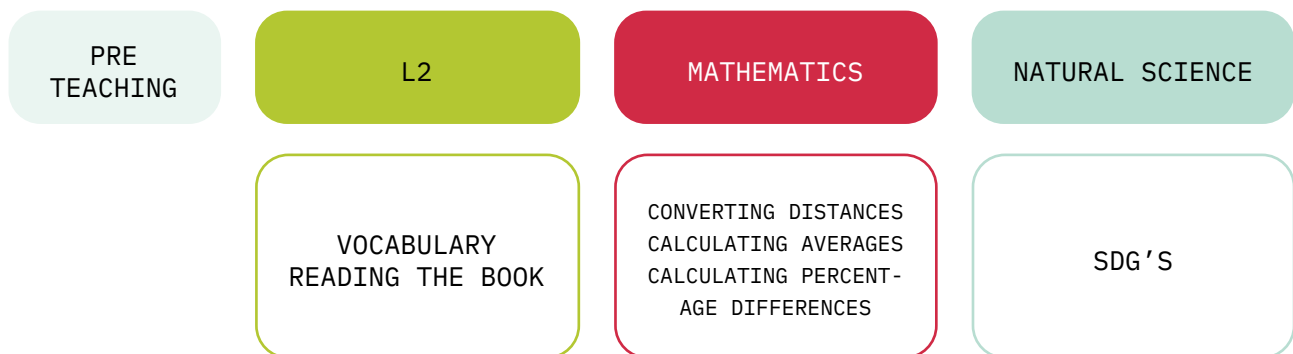
Language support for the students: Let the students work with this language tool to get language support during the STEAM lessons.

Each of the following activities is introduced by a few suggestions for the L2 teacher. Based on the specific characteristics of the class, the teacher may decide whether or not to use certain resources.

Where certain activities involves previously acquired knowledge, suggestions are provided for additional activities to introduce this knowledge and skills.



11. CONCEPT MAP



12.1 PRE PROJECT ACTIVITIES

INTRODUCING THE STORY



Pre-teaching of some vocabulary (L2).

Suggestion for L2 teachers

Introduce the book *Luz Sees the Light*. Use the activities provided in this document to work on the story and vocabulary before starting the science tasks based on the comic narrative, in order to establish the context of the unit



30-100'

TIPS FOR
TEACHERS



YOUTUBE AUDIO
VERSION OF THE BOOK

SDG MATCH-UP GAME

If SDGs have not yet been addressed, this specific activity (or an alternative activity) can be provided for this.

Students connect SDGs to real-life problems.

- Show **images of global problems** (e.g., plastic pollution, deforestation, poor working conditions, droughts).
- Give students **SDG cards** (with the 17 SDG icons).
- In groups, they match the **SDGs to the problems** and explain their choices.

Discuss the answers as a class.



25-40'



WEBSITE WITH
INFORMATION



VIDEO



ALTERNATIVE ACTIVITIES

SGD Impact walk

30-45'

Goal: Students realize how SGDs connect to their daily lives.

How?

Print or display different SDGs with short explanations around the classroom or school. Give students a worksheet with everyday activities (e.g., buying food, wearing clothes, traveling).

Students walk around, stopping at each SGD station to note how it links to their daily lives. Final discussion: Which SDGs had the biggest impact? Which were surprising?

SDG Escape Room

45-60'

Goal: Students discover the SDGs through puzzles and challenges.

- Set up 5-6 stations in the classroom, each linked to a specific SDG.
- Each station has a short challenge (e.g., a riddle, a short video with a question, a match-up game).
- Students complete the tasks and earn a code to unlock the next step.
- Final task: Match the SDGs with real-world problems and possible solutions.

Example challenges:

- SDG 6 (Clean Water & Sanitation): Solve a puzzle about how many litres of water are needed to produce a pair of jeans.
- SDG 12 (Responsible Consumption & Production): Rank products based on their environmental impact.
- SDG 8 (Decent Work & Economic Growth): Read a short case study about fair trade and decide which choices are the fairest



CALCULATIONS (MATHEMATICS): CONVERTING DISTANCES, CALCULATING AVERAGES AND PERCENTAGE DIFFERENCES (MATHEMATICS)



35-70'

This project briefly covers the above calculations. If students are not yet familiar with these or additional practice is desired to make this go smoothly as part of the project, these are some possible preparatory activities that can be covered in the maths lesson.

Exercise 1: Renewable energy (converting distances) 10-20'

Objective: Practice converting distances between different units using examples related to renewable energy sources.

Instructions:

- Provide students with distances related to renewable energy installations (e.g., the height of wind turbines, the length of solar panel arrays).
- Ask them to convert each distance to metres.

Example:

- Convert the height of a wind turbine (150 metres) to centimetres.
- Convert the length of a solar panel array (2.5 kilometres) to metres.

Formulas:

- To convert kilometres to metres:

$$\text{metres} = \text{kilometres} \times 1000$$

- To convert metres to centimetres:

$$\text{centimetres} = \text{metres} \times 100$$

Exercise 2: Energy consumption (Calculating Averages) 10-20'

Objective: Calculate the average energy consumption of households over multiple months.

Instructions:

- Provide students with the monthly energy consumption (in kWh) of a household over several months.
- Ask them to calculate the average energy consumption

TIPS FOR
TEACHERS

Exercise 1:

Using a conversion table can help students.

Exercise 2 : Deepening/extension

Explain to the students the relationship between kilowatt-hour (used in the exercise) and joules (unit of energy).

Energy is measured in **joules (J)**, but for larger amounts of energy, we often use **kilowatt-hours (kWh)**. One **kilowatt-hour (1 kWh)** is equal to **3.6 million joules (3,600,000 J)**.

Why?

- A **watt (W)** is a measure of power, which is how fast energy is used.
- **1 kilowatt (kW) = 1,000 watts.**
- When a 1,000-watt (1 kW) device runs for **1 hour**, it uses **1 kWh of energy**.
- Since **1 watt = 1 joule per second**, a 1 kW device running for **1 hour (3,600 seconds)** uses:
 $1,000 \text{ W} \times 3,600 \text{ s} = 3,600,000 \text{ J (3.6 MJ)}$.

So, when you calculate energy in **kWh**, you are measuring how much energy is used over time. If a household uses **300 kWh** in a month, that means they have consumed **1.08 billion joules (1,080,000,000 J)**!

Example:

- Monthly energy consumption: 320 kWh, 300 kWh, 310 kWh.
- Calculate the average energy consumption.

Formula:

- Average energy consumption:

$$\text{average} = \frac{\text{sum of consumption}}{\text{number of months}}$$

Exercise 3: Carbon emissions (Percentage differences) 15-30'

Objective: Calculate the percentage difference in carbon emissions between different countries.

Instructions:

- Provide students with the carbon emissions of different countries (e.g., in metric tons).
- Ask them to calculate the percentage difference between each country and the country with the lowest emissions.

Example:

- Country A emissions: 500 metric tons.
- Country B emissions: 450 metric tons.
- Calculate the percentage difference.

Formula:

- Percentage difference:

$$\text{percentage difference} = \left(\frac{\text{higher emissions} - \text{lower emissions}}{\text{higher emissions}} \right) \times 100$$

12.2 PROJECT ACTIVITIES

ACTIVITY 1

MAKING A VEHICLE THAT MOVES ON HIS OWN



3-5hs

Suggestion for L2 teachers

What? Support students in using functional and scientific language during group work and prototyping.

Why? This helps learners express design choices, collaborate effectively and reflect on their process in the target language.

How?

- Revise key terms from the vocabulary list (e.g., friction, axle, energy transfer).
- Use speaking cards (reflection and group work) and role cards
- Refer to the Language Support Database for sentence starters and grammar tips.
- Encourage phrases like:
 - *"I think this material is more efficient because..."*
 - *"Can you explain why this shape works better?"*
 - *"Let's test this subsystem and record the results."*



VOCABULARY
LIST



SPEAKING
CARDS



ROLE
CARDS



LANGUAGE
SUPPORT
DATABASE

1.1 Introduction and link to the book

"Let's start by thinking back to the book Luz Sees the Light. Luz learns that even small changes can make a big difference when it comes to saving energy and protecting the environment. She discovers how important it is to find creative, sustainable solutions to everyday problems.

Today, we're going to be just as creative as Luz! Instead of using fuel or electricity to power something, we'll build a car that runs entirely on stored energy – using a rubber band."

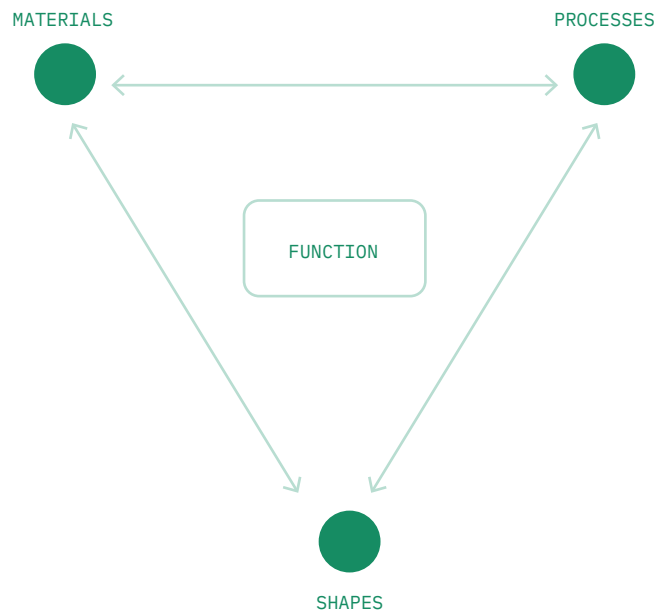
1.2 Function triangle

30-45'

Materials:

- Projector/screen and laptop for displaying images
- Image of the function triangle
- Example objects to explain the function triangle (e.g., glasses, phone, chair)
- Worksheets or notebooks for students to take notes

Show an image of the function triangle



This triangle helps us think about how technology works.

- At the centre is the **function**: What do we want our car to do? (Move forward using only a rubber band for energy!)
- Around the triangle, we think about three things:
 - **Materials**: What will we use to build it? Can we choose materials that are light, strong, and eco-friendly, like Luz would want?
 - **Shapes**: How will the parts of the car look and fit together? For example, how can we make the wheels round so they roll smoothly?
 - **Operations/processes**: How will we connect and build the parts? Will we cut, glue, or tape? What steps do we need to follow?

Ask students **how engineers are using this** in their profession if they have to design something...Have students deliberate in pairs.

If they do not find an answer, use questions to explain the importance of the job triangle with a concrete example.

Show the pupils a pair of glasses and explain the example:

Example:

Development of glasses

- **Function**: Help improve vision and be comfortable to wear.
- **Materials**: Titanium (light and strong for the frame), plastic or glass (for the lenses).
- **Shapes**: A frame that fits different face shapes and fits snugly around the ears and nose.
- **Operations/processes**: Precision machining of the frame, polishing of lenses, and assembly.

- **Application:** Designers have to choose whether they design glasses that are fashionable (e.g. thick plastic edges) or practical (e.g. thin titanium frames). The function triangle helps to balance aesthetics and functionality

1.3 Make the link with renewable energy

15-30'

Materials:

- 3D model or scale model of a wind turbine
- Pictures or posters of wind turbines with visible subsystems
- Worksheets for identifying functions, materials, shapes, and processes

Show a 3D-model of a wind turbine/windmill + some pictures and ask students to name the subsystems.

Subsystems: The rotor blades, the shaft, the generator, and the transmission system.

Ask students to name a wind turbine subsystem's function, materials, shapes and operations/processes.

Example:

Rotor blades

- **Function:** These capture the wind and turn it into rotational energy.
- **Materials:** Composite materials (e.g., fiberglass, carbon fiber) for strength and lightweight.
- **Shapes:** Aerodynamic shapes to maximize wind capture.
- **Operations/processes:** Moulding and curing of composite materials, surface finishing.

1.4 Addressing the design question: How do we make a car that doesn't run on electricity or batteries?

60-90'

Materials:

Design phase

- Computers or tablets for online research (e.g., searching for rubber band cars)
- Worksheets with the function triangle and subsystem analysis
- Paper and pencils for sketching
- Brain sketching templates
- Sticky dots for voting

1.3 Link to renewable energy

Info about the other parts of a windmill:

Function:

- **Shaft:** This transfers the rotational energy from the rotor blades to the generator.
- **Generator:** This converts the rotational energy into electrical energy.
- **Transmission System:** This adjusts the speed of the rotation to make sure the generator works efficiently.

Materials:

- **Rotor Blades:** Shaft: Steel for durability and strength.
- **Generator:** Copper (for windings), steel (for structure).
- **Transmission System:** Steel and composite materials for gears and housing.

Shapes:

- **Rotor Blades:** Aerodynamic shapes to maximize wind capture.
- **Shaft:** Cylindrical for efficient rotation.
- **Generator:** Compact and robust design to fit within the nacelle.
- **Transmission System:** Optimized gear shapes for efficient power transfer.

Operations/Processes:

- **Rotor Blades:** Moulding and curing of composite materials, surface finishing.
- **Shaft:** Forging, machining, and heat treatment.
- **Generator:** Winding of copper coils, assembly of components.
- **Transmission System:** Precision machining of gears, assembly, and lubrication.

Alternative for groupwork in groups of 4: expert groups

Each expert group delves into one of the subsystems and then shares its knowledge in a mixed group.

Doing so, a link can be made to how in companies experts also pool their knowledge with other experts.

Possible extension/alternative

The expert groups could also include research questions such as 'how does independent variable A affect dependent variable B?' In this way, students could address different research questions (per expert group).

"Average distance is the dependent variable in each case. Examples of independent variables are 'contact area', 'vehicle mass', 'vehicle volume',..."

Suggestion for

L2-teachers: help the students to communicate with each other within the group work using Speaking Cards with sentences to better guide the group event. (Speaking cards: Reflecting)

Suggestion for

L2-teachers: let the students make use of this tool to help them formulate their ideas and answers.



LANGUAGE
SUPPORT
DATABASE

Prototyping and building

- Elastic materials for testing (to determine the best energy storage material):
 - Different types of rubber bands
 - Elastic cords (e.g., bungee cord)
 - Balloons (for elastic energy storage)
 - Springs (optional for comparison)
- Basic construction materials:
 - Lightweight wood (e.g., popsicle sticks, balsa wood)
 - Cardboard
 - Plastic bottles or caps, Cd's... (for wheels)
 - Straws (for axles)
 - Skewers or thin wooden sticks
 - Glue (craft glue or hot glue)
 - Tape (duct tape or masking tape)
 - Scissors and utility knives
 - Rulers and measuring tapes
 - Markers/pens

Present the requirements for the vehicle to the students

- the vehicle must be able to move independently (drive, slide) for 3 metres
- the vehicle is powered by a rubber band
- the *maximum* dimensions are 30 cm (L) x 15 cm (W) x 20 cm (H)
- Must be sturdy enough to do several test drives

Explain the way they are going to perform this task

- Working in groups of 4
- Following a roadmap provided by the teacher:
 - Functional triangle (recap)+ drawing the triangle
 - Answering the sub-question: What are the **subsystems** of the existing examples of rubber band cars?



ROADMAP
(STUDENT
WORKSHEET)

Explain to the students that by answering the following questions, they can determine what their car (being a system) needs as parts (subsystems) to function (*crosscutting concepts: systems and system models/cause and effect):

- What are the essential parts of your vehicle, and how do they work together?
- If you remove or change one part (e.g., a wheel, axle, or rubber band), what happens to the movement of the car?
- Looking up examples and their subsystems using the *search term*: rubber band cars
- Noting down which subsystems the rubber band cars have
- Answering the question: **Which materials are suitable** for building a rubber band car? (Crosscutting concept: Structure and function)

- Which materials are light?
- Which materials are heavy?
- Which materials break quickly?
- Which materials are round?
- **Brainstorming** to answer the question: Which model will we use to make our rubber band car?
- Choose the **roles** that everyone in the group will take on
- *Answer the questions and fill in the table:*
 - Which materials will we use per subsystem?
 - Which shape does each subsystem need?
 - How are we doing to make sure that each subsystem works properly?

The students use their answers to complete this table

TECHNICAL SYSTEM	RUBBERBAND CAR				
		FUNCTION	MATERIALS	SHAPES	PROCESSES
SUBSYSTEM 1	Energy transfer system	Convert the stored energy in the rubber band into motion			
SUBSYSTEM 2	Wheel and axle system	Ensure smooth rolling motion and transfer the energy from the axle to the ground			
SUBSYSTEM 3	Chassis on frame system	Provide structure to hold all parts together and support overall design			
SUBSYSTEM 4 OPTIONAL	Steering and alignment system	Ensure the car moves in a straight line without veering off course			

After completing the table, students are ready to draw their ideal prototype, also indicating the subsystems. They do this by **brain sketching**.

First 3x3 minutes

- Give each student a template
- During first 3 minutes each student draw his own idea of the prototype in column 1
- They pass the template to the neighbour (clockwise)



TEMPLATE BRAIN SKETCHING

Extra digital skills:

There is scope to deploy simulation software or digital design programmes to optimise the prototype virtually. This can be a valuable addition to test design choices before they are physically implemented. (Digital content creation)

Why Brain sketching is effective for prototyping?

Brain sketching is a brainstorming technique where ideas are sketched and iteratively improved. It works especially well for group projects like designing a rubber band car.

Benefits:

- **Boosts creativity:** Visual thinking helps generate innovative solutions, while contributions from different students enrich ideas.
- **Encourages collaboration:** Everyone participates and provides feedback, leading to a more refined prototype.
- **Reduces barriers to participation:** Sketching is low-pressure, making it easier for all students to contribute.
- **Enhances problem-solving skills:** Iterative sketching helps students identify challenges and refine their designs.



OTHER
TECHNIQUES

- Second 3 minutes they either draw an alternative to the sketch (column 1) in the second column OR draw a new prototype in the second column
- They pass the template to the neighbour (clockwise)
- The previous step is repeated in the third column

Next 3x3 seconds = sticky dot

- Every student has 3 sticky dots
- The teacher counts '3-2-1' and says 'sticky dot'
- This is the sign for the students to put a sticky dot next to their favourite drawing
- The previous step is repeated three times

The prototype with most sticky dots is the one the group has chosen to realise.

Prototyping

- Create a sketch of the vehicle and all its subsystems in detail.
- Ensure that all parts fit together; don't forget to note down the dimensions.
- Divide the tasks among group members.
- Let students fill in the table!!! (subsystems/dimensions/responsible student/materials/processes)
- Determine the order in which the tasks will be completed.
- Gather all the materials you will need.
- Build your prototype!

1.5 Test the cars: the class race!**30-40'****Materials:**

- Measuring tape (at least 3 metres)
- Worksheet for recording distances
- Race track or start and finish line markers

All cars will do three trips and then be compared based on their average distance on those three trips.

To make the crosscutting concept Patterns more explicit to the students, ask them the following questions:

- Why do we run each vehicle three times instead of just once? (Steer them towards the idea of reliability and consistency in results.)
- What would happen if we only did one test drive? Would we be sure the results were correct? (Here they can think for themselves that one measurement could happen to be good or bad).

- Why do we average the three rides? What does this tell us about vehicle performance? (This leads to the idea that a pattern becomes more reliable if you have more data.)
- Why do we compare the results of all vehicles? What can we learn from this?
- (They may discover that it helps to see trends: which designs work better and why?)

Let the cars race!

- Record the distance travelled by each car in metres.

$$\text{metres} = \frac{\text{centimetres}}{100}$$

$$\text{metres} = \text{kilometres} \times 1000$$

- Calculate the average distance for each car over multiple tests.

$$\text{average} = \frac{\text{sum of distances}}{\text{number of tests}}$$

- Determine the percentage difference between each car and the winning car.

$$\text{percentage difference} = \left(\frac{\text{winning car distance} - \text{other car distance}}{\text{winning car distance}} \right) \times 100$$

1.6 Reflection

20-40'

Materials:

- Worksheet with reflection questions
- Flipchart or whiteboard for collecting patterns and insights

The student roadmap includes some closed reflection questions. These can be used as a basis to help students next class reflection questions.

Reflecting on winning results

If we look at all the results, do we see similarities or differences between the best vehicles? What could that mean?

(This is where you explicitly help them recognize patterns and make connections between design and performance). (Crosscutting concepts: Patterns/Cause and effect/Structure and function)

1.4 Prototype suggestion for L2-Teachers



ROLE
CARDS

1.5 Extra digital skills

Students can use digital measurement tools or apps to accurately measure the distances of prototypes. They can then enter the collected data into spreadsheets, generate graphs and analyse trends. (Information and data literacy - Data collection and analysis)

1.6 Suggestion L2-Teachers:



SPEAKING CARDS
(REFLECTING)

Reflecting on own car

- What worked best on your car?
- What didn't work so well?
- Why could this have happened?

Reflecting on process

- How did the groupwork go?
- What could have gone better?
- What were you responsible for?
- What's one thing I will do differently next time?



ACTIVITY 2

ENERGY AND FORM OF ENERGY



90-120'

Suggestion for L2 teachers

What? Help students describe and categorize energy types using academic vocabulary.

Why? This reinforces scientific understanding and supports language development through classification and reasoning.

How?

- Pre-teach or revise terms from the vocabulary list (e.g., kinetic, thermal, chemical).
- Use speaking cards to guide peer questioning and justification.
- Use the Language Support Database to model passive voice and cause-effect structures.
- Encourage phrases like:
 - *"Energy is converted from potential to kinetic."*
 - *"If we reduce friction, the car will travel further."*
 - *"This is an example of thermal energy because..."*



VOCABULARY
LIST



SPEAKING
CARDS



LANGUAGE
SUPPORT
DATABASE

In a prior activity within technology, students create a prototype of a vehicle (rubber band car). They start will optimize their product after this activity (lesson on energy).

2.1. Answering the research challenge

10'

First ask the students what they have learned/done so far.
(Function triangle: shapes, materials, processes/First prototype: planning/building/testing/reflecting)

Ask the students why **Luz and ourselves need/use energy?**

- They can use the interactive image to discover the uses of energy at home, in nature and at school. This allows them to see it's applications and help them answer the question above.
- The examples are written down on the worksheet Energy



INTERACTIVE
IMAGE



ENERGY
WORKSHEET

Ask enough supplementary questions to their answers to get to the following **definition of energy:**

- 'Energy is what you need to change something'.

Show the pupils a list of forms of energy *

- **Potential** energy
- **Kinetic** energy
- **Thermal** energy
- **Chemical** energy
- **Electrical** energy
- **Light** energy

2.2 Explain the different forms of energy by using examples and demonstrating it. 15-25'

Materials:

- Objects to demonstrate each form of energy
- Presentation



ENERGY	DEFINITION	DEMONSTRATION (EXAMPLES)
POTENTIAL ENERGY (Presentation Slide 5)	Potential energy = Energy that is stored	Gravitational potential energy: dropping an object
		Elastic potential energy: stretching a rubber band
KINETIC ENERGY (Presentation Slide 6)	Kinetic energy = energy in motion	Rolling a ball
		Pushing a toy car
THERMAL ENERGY (Presentation Slide 7)	Thermal energy = energy produced by the movement of particles which produces heat.	Hands rubbing together
		Sanding wood
		Spoon in hot water
CHEMICAL ENERGY (Presentation Slide 8)	Chemical energy = energy that is produced by a chemical reaction.	Vinegar and baking soda reaction
		Use a battery to power a small light bulb or motor
ELECTRICAL ENERGY (Presentation Slide 9)	Electrical energy = energy that is produced by charged particles	Simple circuit with a battery
LIGHT ENERGY (Presentation Slide 10)	Light energy = radiation (produced by rays of light)	Flashlight in a dark room
		Shine a flashlight at a solar-powered calculator

2.3 After this demonstration and explanation, the students recap the information by working in pairs. 10-15'

Materials:

- Flashcards:
 - Orange = examples
 - Green = energy forms
 - Blue = definitions



FLASHCARDS



SHEET TO SORT THE
FLASHCARDS

Instruction:

- The colours of the cards correspond to the colours of the titles of each column on your sheet
- Look at each example and then also place the matching green and blue card with the example
- When you have finished, ask the teacher to check

When all groups are finished: **let them check themselves.**

- In preparation of this each group has to formulate questions to ask other groups.
- They have to consider how to defend their own definitions and examples: why did they place this example under this form of energy? Why did another group place it somewhere else?

Let **one student of each pair** go to maximum 3 other groups to ask the prepared questions. The second student answers the questions about the pairs choices to visiting students.

On the worksheet a half-filled table is provided. The students fill in the gaps (see presentation slide 13).

Linking back to the prototype:

Ask the students: "What kind of energy does your rubber band car use?"

- Potential energy (see presentation slide 16).
- Unscrambling the sentences on the worksheet to reveal the energy used in the prototypes (see presentation slide 17).

2.4 Difference between energy conversion and energy transfer

15-20'

The use of the word “converted” in the first sentence, should help students decide for themselves what the correct definition of energy conversion is.

Give some examples to show students that we can’t see energy directly.

“Energy is something we can’t see directly, but we can see its effects and how it changes from one form to another. For example, when you turn on a light bulb, electrical energy is transformed into light and heat energy. Similarly, when you eat food, your body converts the chemical energy in the food into the energy you need to move and grow” (see presentation slides 18 and 19).



PRESENTATION

Now that students have learnt the difference between energy conversion and energy transfer, we first **link energy conversion back to our prototype** and then see how this process works for a **lightbulb** (new context).

This forms the transition to the phenomenon of **heat as a side product** to arrive at the law of **conservation of energy** (see presentation slides 20 and 22).

Explain to students that the amount of heat (thermal energy) produced added to the amount of light (light energy) produced corresponds to the amount of electrical energy in this diagram. Thus no energy is lost.

Conservation of energy

In a closed system, total energy remains constant, only energy conversions and energy transfers happen (see presentation slide 24).

Linking back to the prototype.

Ask the students is there was any other energy produced besides kinetic energy? What other energy could be produced which stops the car from going far? (see presentation slide 25)

2.5 Reflection questions

15-20'

- What happens to the energy when your car stops moving? Where does it go?
(When the car stops moving, the kinetic energy is transformed into other forms, mainly heat and sound, due to friction with the ground and air resistance)

- Can energy disappear? Why or why not?
(Energy cannot disappear; it can only change from one form to another. This is due to the law of conservation of energy, which states that energy is never created or destroyed, only transformed.)

(Crosscutting concept: Energy and matter)





ACTIVITY 3

MODIFYING THE PROTOTYPE

In this activity students use their knowledge from activity 2 to optimize their prototype.

Suggestion for L2 teachers

What? Support students in explaining design improvements and presenting results.

Why? This fosters confidence in using English to describe technical changes and interpret data.

How?

- Reuse terms from the vocabulary list (e.g., resistance, optimization).
- Use speaking cards for presenting and reflecting.
- Use the Language Support Database to scaffold comparative and analytical language.
- Encourage phrases like:
 - "Our modified car travelled 20% further."
 - "We reduced friction by changing the wheel material."
 - "Compared to the first prototype, this one is more stable."



VOCABULARY
LIST



SPEAKING
CARDS



LANGUAGE
SUPPORT
DATABASE

TIPS FOR TEACHERS

3.1

***Why using a template such as Criteria for a good design question?**

Using a recognisable template for skills such as creating a research question/design question helps lock in the sub-steps with learners. Step by step, they are thus guided to apply the intended skills independently.

Differentiation: if pupils already have experience with design questions, they can also be asked to draw up a good design question for their prototype.

3.1. Introduce the design question

10-15'

Explain to students that now that they have learned more about energy, they can improve their car's performance. Therefore, there are **modified** requirements for their car:

- the vehicle must be able to move independently (drive, slide) for 4 metres*
- no batteries or motors may be used
- the maximum dimensions are 30 cm (L) x 15 cm (W) x 20 cm (H)

* 1 metre beyond minimum for prototype

Ask students to describe in a short sentence, in their own words, what their task is.

'Modifying the prototype so that it travels a greater distance.'

Articulate what a good design question should meet.*

Ask the pupils how they could improve the prototype they already made?



CRITERIA FOR
A GOOD DESIGN
QUESTION

Guide students to arrive at the classroom formulation of the design question.

This can involve referring back to the presentation slide 13 from activity 2.

'Turning as much potential energy into kinetic energy as possible'

'Keeping frictional heat as small as possible'.

TIPS FOR TEACHERS

3.2. Brainstorm

15-20'

Materials:

- Large sheets of paper for brainstorming
- Markers and pens
- Sticky notes
- Student notes/drawings from Activity 1

3.2

Alternative/ extra

challenge: let students modify a prototype build by another group...

Get groups from activity 1 to work together again.

Questions for the brainstorm:

- How can we increase potential energy?
- How can we reduce friction?
- In which subsystems can we do this?

Have students reuse their notes/drawings from Activity 1 and add comments:

TECHNICAL SYSTEM	RUBBERBAND CAR				
		FUNCTION	MATERIALS	SHAPES	PROCESSES
SUBSYSTEM 1	Energy transfer system	Convert the stored energy in the rubber band into motion			
SUBSYSTEM 2	Wheel and axle system	Ensure smooth rolling motion and transfer the energy from the axle to the ground			
SUBSYSTEM 3	Chassis on frame system	Provide structure to hold all parts together and support overall design			
SUBSYSTEM 4 OPTIONAL	Steering and alignment system	Ensure the car moves in a straight line without veering off course			

**Suggestion for L2 teacher:
Speaking cards**

- Group work
- Presenting
- Reflecting

Guide students in this reworking of their prototype by using **guiding questions:**

- Where is your potential energy?
- How can you increase that potential energy?
- Which parts of the vehicle generate frictional heat?
- How can you reduce the heat of friction?

3.3. Preparing to modify the rubber band car**10-15'**

- Which materials will we use this time?
- Which parts of the subsystem will change?
- How will we change it?
- Who will do what?

3.4. Application of the improvements**20-30'****Materials:**

- Rubber bands (various sizes and strengths)
- Lightweight wheels (plastic lids, CDs, wooden discs)
- Axles (wooden skewers, metal rods, drinking straws)
- Chassis materials (cardboard, wood, plastic sheets)
- Tape (duct tape, masking tape)
- Glue (hot glue, strong adhesive)
- Scissors and craft knives
- Rulers and measuring tape

Once the adjustments have been made, students are given a few minutes to prepare their presentation and demonstration.

Questions students need to answer during presentation:

- Is more potential energy converted to kinetic energy? How do we know this?
- Have we reduced the friction? How can we tell?

3.5. Testing the modified cars = class race!**15-20'****Materials:**

- Measuring tape of ruler stick
- Open floor space or racetrack

Each groups presents and demonstrate their vehicle. They explain what they've done to convert as much potential energy into kinetic energy as possible while minimizing frictional heat.

Use the same method as in activity 1.

3.6. Reflection questions

10-15'

Some suggestions:

- **On the cars in general**

(Crosscutting concept: Patterns)

- What happens if you compare results with another group that used different materials? Are there any similarities in performance?
- What design factors seem to make the biggest difference in how far or how straight the car moves?
- (Crosscutting concept: Stability and change)
- How do small adjustments (e.g., axle alignment, rubber band tension) create big changes in performance?
- (Crosscutting concept: cause and Effect)
- What happens if you stretch the rubber band more before releasing the car?
- How does changing the wheel size affect how far the car travels?

- **On own car**

- Which changes worked well?
- Which changes didn't work well?
- If you could make it again, what would you do differently?

- **On the process**

- How did the groupwork go?
- What could have gone better?
- What were you responsible for?
- Did the groupwork improve during the second part of making the prototype?

3.6. Linking the activity with sustainable energy use 15-20'

Materials:

- Images of wind turbines, solar panels, and energy-efficient building

Show the picture of the wind turbine (activity 1 - subsystems and function triangle) to students again.

Have them explain how the chosen subsystem (rotor blades) from activity 1 can contribute to the optimisation of the wind turbine?

- **Optimization:** Designing rotor blades to capture maximum energy from the wind and placing turbines in locations with consistent wind patterns.
- **Example:** Explain how aerodynamic designs of rotor blades and strategic placement of wind turbines can maximize energy output.

TIPS FOR TEACHERS

3.6

Using (interactive) pictures that clearly illustrate the examples is a good support both towards the content and towards the use of L2.

3.6

Extension/depth

If students already have a notion of research skills, they can conduct research on examples of renewable energy.

In doing so, they can create their own research plan (see Lesson Plan 2 and Lesson Plan 3 for examples of step-by-step plans/roadmaps). These can include more or less advance information by the teacher (depending on the group's experience).

Extra digital skills:

Planning and conducting research on examples of renewable energy and prototyping can be supported by digital resources and the internet. As a result, students learn to find, evaluate and apply information effectively. (Online research)

Explain to students the concept of subsystems and their contribution to energy efficiency in following examples:

a. Solar panels

Subsystems: The solar panels themselves, the inverter that converts the generated power, and the battery storage (if present).

- **Example:** Explain how each part of the solar energy system contributes to the overall energy production and storage. The solar panels capture sunlight, the inverter converts it into usable electricity, and the battery stores excess energy for later use.

Optimization of energy transfer: Positioning solar panels at an optimal angle and location to ensure maximum exposure to sunlight.

- **Example:** Discuss how the correct placement of solar panels can increase the amount of energy generated and how this contributes to more efficient use of solar energy.

b. Wind turbines

Subsystems: The rotor blades, the shaft, the generator, and the transmission system.

- **Example:** Discuss how the rotor blades capture kinetic energy from the wind, which is transferred via the shaft to the generator to produce electricity. The transmission system ensures that the generated electricity is sent to the power grid.

Optimization of energy transfer: Designing rotor blades to capture maximum energy from the wind and placing turbines in locations with consistent wind patterns.

- **Example:** Explain how aerodynamic designs of rotor blades and strategic placement of wind turbines can maximize energy output.

c. Energy efficiency in buildings

Subsystems: Insulation materials, windows, heating systems, and ventilation systems.

- **Example:** Explain how well-insulated walls and windows reduce heat loss, meaning the heating system uses less energy to keep the building warm. Ventilation systems can also help improve energy efficiency by recovering heat from exhausted air.

Optimization of energy transfer: Using high-quality insulation materials and energy-efficient windows to minimize heat loss.

- **Example:** Discuss how using double glazing and well-insulated walls can improve a building's energy efficiency, leading to lower energy costs and a smaller ecological footprint.

Concluding:

Ask students to make the link between energy conservation and the environment in their own words.

"By saving and using energy more efficiently, we reduce the demand for fossil fuels and contribute to a more sustainable future. Using renewable energy sources like solar and wind power helps reduce greenhouse gas emissions and conserve natural resources."





ACTIVITY 4

CONCLUDING ACTIVITY: SDG REFLECTION AND PRESENTATION

In this activity students reflect on the activities they have carried out and how these contribute to the SDGs.

This activity not only helps students reflect on their learning process but also strengthens their presentation and collaboration skills. It highlights the practical application of their knowledge and the relevance of the SDGs in their daily lives.

Suggestion for L2 teachers

What? Guide students in linking their project to global challenges using SDG-related vocabulary.

Why? This promotes intercultural awareness and helps students articulate impact in English.

How?

- Use speaking cards to support group discussions and presentations.
- Use the Language Support Database to help students structure their arguments.
- Encourage phrases like:
 - "Our project supports SDG 7 because..."
 - "This design reduces energy waste by..."
 - "We learned that small changes can have a big impact."



SPEAKING
CARDS



LANGUAGE
SUPPORT
DATABASE

4.2-4.5

Info: link between the activities and the SDGs

SDG 7: Affordable and Clean Energy

- The project teaches students about different forms of energy, energy conversion, and conservation.
- By linking their prototype vehicle to real-world sustainable energy solutions (solar panels, wind turbines, energy-efficient buildings), students gain insight into how clean energy works and why it is essential.
- They explore how optimising energy use in small systems (their vehicle) relates to broader sustainability efforts.

4.1. Linking to SDGs (repeat of introduce)

10-15'

Materials:

- Internet access to view the SDG website
- SDG cards or posters (optional)

Ask students what SDGs are because they are the focus of this activity.

A short repetition or introduction will suffice here.

"The Sustainable Development Goals (SDGs) are 17 goals created by the United Nations to make the world a better place by 2030. These goals focus on problems like poverty, pollution, climate change, and fair working conditions. In this project, we will look at how fast fashion and the food industry affect some of these goals."



EXPLORE
SDG GOALS

4.2 Project review

10-15'

Start with a brief review of the main activities and learning objectives of the project.

Discuss the concepts of energy conservation, energy transfer, and optimization of energy in the context of the rubber band car, solar energy, wind energy, and energy efficiency in buildings.

4.3 Group discussion

15-20'

Divide the class into small groups and assign each group a specific SDG that was addressed during the project (e.g., SDG 7, SDG 12, SDG 13).

Have each group discuss how the activities they performed contribute to their assigned SDG.

Encourage them to use specific examples from the project.

4.4 Creative Presentation

20-25'

Materials:

- Craft materials
- Computers and software (possibly)

Ask each group to present their findings in a creative way. This could be a poster, a short presentation, a role-play, or another creative medium.

Allow the groups enough time to prepare their presentations and develop their ideas.

4.5 Reflection and discussion

10-15'

Conclude the activity with a class-wide discussion about what they have learned about the SDGs

Discuss how they can apply the knowledge and skills they have gained in their daily lives and future projects

SDG 12: Responsible Consumption and Production

- The project encourages students to think critically about energy efficiency and minimizing waste (e.g., reducing frictional heat in their vehicle to maximize movement).
- By discussing real-world applications of energy conservation, such as energy-efficient buildings, students learn how responsible design choices reduce environmental impact.

SDG 13: Climate Action

- The project highlights the importance of energy conservation in reducing reliance on fossil fuels and lowering greenhouse gas emissions.
- Students make connections between their small-scale prototypes and large-scale sustainable energy solutions that help mitigate climate change.

Creative presentation extra examples:

- A digital representation: an infographic, an interactive image...
- A cartoon-style poster (such as Luz sees the light)



PROJECT ASSESSMENT

Content (see rubric appendices)

Possible evaluation methods:

- Individual reflection report:
 - Students write a personal report reflecting on their learning process and campaign impact.
- Prototype testing & data analysis report:
 - Students document their design process, record test results (e.g., distances travelled, energy efficiency), and explain how changes improved performance. This report can include graphs, photos, and reflections on design decisions.
- Group reflection & peer feedback session:
 - During and after the prototyping and testing phases, students participate in guided group discussions where they reflect on their design choices, collaboration, and learning. Peers can provide constructive feedback using a simplified version of the rubric.
- Interactive presentation with Q&A and demonstration:
 - Each group presents their final prototype along with their testing data and SDG connections. A Q&A session follows, where teachers, peers, or external experts ask questions about design decisions, energy conversions, and sustainability aspects.
- Portfolio assessment:
 - Students compile a portfolio that includes their design sketches, the completed function triangle, test data sheets, photographs of their prototypes, written reflections, and notes from group discussions. This portfolio demonstrates the evolution of their project from initial ideas to the final outcome.
- Teacher observation & checklist:
 - Throughout the project, the teacher uses a structured checklist to observe and record group interactions, effective application of energy concepts, problem-solving strategies, and overall engagement during key phases such as brainstorming, prototyping, and the SDG reflection activity.

Language (see rubric appendices)

TIPS
FOR TEACHERS

The criteria in the provided rubrics can be used formatively for feedback during the process or summatively for final assessment.

Assessment: see rubrics appendices.





2.2 SMART GREEN- HOUSE

1. SUBJECTS



Natural Science



Mathematics/ Technology



L2

2. PROJECT GOALS, LEARNING OBJECTIVES AND FINAL PROJECT

- Understand how plants grow and the parameters affecting their growth.
- Comprehend photosynthesis and its requirements.
- Explore modifications for greenhouses to influence parameters (e.g., designing coverings, adding doors, insulation).
- Understand the importance of the short food chain (linking to Luz).
- Recognize how technology can contribute to sustainability.
- Program a computer or microcontroller.
- Correctly connect and read sensors.
- Properly control actuators.
- Accurately measure relevant parameters (e.g., temperature, light intensity, and soil moisture) and record the data.
- Calculate percentages, such as the soil moisture level relative to the optimal value.
- Use ratios to calculate adjustments, such as the amount of water needed to reach a certain soil moisture level.
- Calculate the surface area and volume of a greenhouse, including the required materials like glass or insulation.
- Use geometric shapes (e.g., rectangles and triangles) when designing the greenhouse.
- Interpret the data and represent it in graphs (e.g., line, bar, or scatter plots).

3. SDGs

This unit is related to the following SDGs:



SDG Goals

- Understand the impact of sustainable food production on global food security (SDG 2).
- Analyse the role of renewable energy sources in greenhouse efficiency (SDG 7).
- Design and implement innovative solutions to optimize plant growth using technology (SDG 9).
- Evaluate how sustainable urban farming can contribute to greener and more resilient communities (SDG 11).
- Develop strategies to minimize resource waste and promote responsible consumption in agriculture (SDG 12).
- Investigate how greenhouse design can help mitigate climate change by reducing energy consumption (SDG 13).

4. CROSSCUTTING CONCEPTS

Teachers make the explicit connections between the project and these concepts during and especially after the project

Systems and system models

Students design and test a “self-regulating” greenhouse, which allows them to understand how different components (such as temperature, light, moisture, and their interaction with the plants) function as a whole. They learn how the greenhouse system affects plant growth and how to adjust the system for better performance.

Cause and effect

Students explore how variables such as light, temperature, and moisture affect plant growth. They learn the relationships between these factors and their effects on plant growth, such as how a change in temperature might lead to changes in photosynthesis.

Structure and function

Students design and build a greenhouse, adjusting its structure (material choice, insulation, doors) to improve its function (optimal growing conditions for plants). This concept is also important when using microcontrollers and sensors, where the function of the technology depends on the correct configuration and structure of the design.

Stability and change

Application in the lesson: Students explore the stability of various parameters in their greenhouse, such as temperature and moisture. They test changes in these variables and learn how the system adjusts (or doesn't) to changes, and how they can optimize systems to maintain stable growing conditions.

Energy and matter

Photosynthesis is a key focus in this project. Students learn how plants use and convert energy (light) into chemical energy, and how they can influence these processes by controlling envi-

ronmental factors like light, temperature, and moisture. This principle is also present when using sensors and microcontrollers, which require energy to collect and process data.

Patterns

Students collect data on various parameters in the greenhouse and look for patterns, such as how temperature and moisture change throughout the day or week. This helps them make better decisions about the greenhouse design and adjusting variables for optimal plant growth.

5. SKILLS

5.1 STEAM SKILLS

All of the STE(A)M-skills are involved in this project.

5.2 DIGITAL SKILLS

- Information and data literacy
 - Browsing, searching and filtering data, information and digital content
 - Evaluating data, information and digital content
 - Managing data, information and digital content
- Digital content creation
 - Programming
 - Integrating and re-elaborating digital content

6. CLIL FRAMEWORK

In this **Smart Greenhouse project**, the 4 C's are introduced this way:

- **Content:** Deepens knowledge in sustainable technology & environmental science.
- **Communication:** Integrates scientific & academic language through meaningful discussions and presentations.
- **Cognition:** Develops critical thinking, analysis, and problem-solving skills.
- **Culture:** Connects the project to global sustainability challenges & real-world applications.

Below is STEAM-based CLIL lesson plans structured using the 4C's framework for the **Smart Greenhouse Project**. In this project, students Investigate sustainable agriculture and technology, guiding them through the design and optimization of automated greenhouse systems.

6.1. THE 4 C'S

4C	DESCRIPTION
CONTENT (Subject knowledge & skills)	• Understanding smart greenhouse technology (automation, sensors, IoT); • Exploring sustainable agriculture methods (irrigation, crop rotation, biodiversity); • Investigating environmental impact (CO₂ emissions, water conservation, renewable energy); • Designing and optimising a smart greenhouse system • Collecting and analysing data on greenhouse performance.
COGNITION (Thinking processes, problem-solving, higher-order skills)	• Analysing research data on sustainable agriculture and greenhouse systems. • Evaluating the efficiency of different designs and materials. • Synthesizing information to create a functional greenhouse prototype. • Applying scientific knowledge to optimize plant growth conditions. • Problem-solving using conditional reasoning ("If we reduce water waste, we can improve sustainability.").

COMMUNICATION (Language for learning, subject-specific vocabulary, discourse functions)	• Vocabulary development: smart greenhouse, climate control, energy efficiency, carbon footprint, resource conservation, automation; • Speaking & discussion: explaining processes, justifying choices, comparing traditional vs. smart greenhouses; • Writing & presentation: research summaries, structured reports, reflective writing; • Functional language for teamwork: assigning tasks (“You will analyze water use, and I will focus on temperature control.”), problem-solving (“If we add solar panels, we will save energy.”), presenting findings (“Our data shows that...”).
CULTURE (Intercultural awareness, real-world application, global challenges)	• Linking to SDGs: Students connect their project to the Sustainable Development Goals (SDG 12: Responsible Consumption, SDG 13: Climate Action, SDG 15: Life on Land); • Global & local relevance: Understanding how food production, climate change, and sustainable technology affect different regions; • Collaborative work: Encouraging team-based problem-solving and communication in a diverse classroom setting; • Real-World connection: Exploring how greenhouse technology is used worldwide for food security and sustainability.

6.2 THE LANGUAGE TRIPTYCH

L2 goals

These **language goals** align with the **lesson objectives** and ensure that students **develop both content knowledge and language skills** throughout the **Smart greenhouse project**.

Language of learning

Goal

Students will acquire and correctly use key vocabulary and grammatical structures related to **smart agriculture, sustainability, environmental impact, and greenhouse technology**.

Objectives

- Identify and use **subject-specific vocabulary** related to smart greenhouses, climate control, and sustainable agriculture.
- Understand and apply **comparatives and superlatives** to analyze the efficiency of different greenhouse models (e.g., “A smart greenhouse is more energy-efficient than a traditional greenhouse.”).

- Use **passive voice** to describe processes within the greenhouse system (e.g., “*Water is distributed automatically through an irrigation system.*”).
- Construct **cause-and-effect sentences** using conditionals (e.g., “*If the temperature rises too high, the system will activate the cooling fans.*”).

Key vocabulary and concepts

- **Smart greenhouse technology:** sensors, automation, climate control, IoT (Internet of Things), energy efficiency
- **Agriculture & sustainability:** irrigation, crop rotation, organic farming, biodiversity, renewable energy
- **Environmental impact:** carbon footprint, CO₂ emissions, resource conservation, waste management
- **Systems thinking:** feedback loops, data monitoring, optimization, efficiency

Vocabulary list

This vocabulary can support the students throughout the project. There is a vocabulary list (with translations) available.



VOCABULARY
LIST

Natural Science & Biology (Photosynthesis & Plant Growth)

- **Photosynthesis** – The process by which plants convert sunlight, water, and CO₂ into energy.
- **Chlorophyll** – The green pigment in plants that absorbs light for photosynthesis.
- **Stomata** – Tiny openings in leaves that allow gas exchange.
- **Transpiration** – The process of water movement through plants and its evaporation from leaves.
- **Plant Growth Factors** – Light, temperature, water, nutrients, and CO₂ levels.
- **Pollination** – The transfer of pollen from the male part of a flower to the female part.
- **Germination** – The process by which a seed develops into a plant.
- **Soil Moisture** – The percentage of water content in soil, crucial for plant health.
- **Nutrient Absorption** – How plant roots take in essential minerals from the soil.

Mathematics & Measurement Terms

- **Measurement** – The process of quantifying data using units.
- **Optimal** – The most favourable conditions for plant growth.
- **Range** – The difference between the highest and lowest values in a dataset.
- **Data Logging** – The process of collecting and storing sensor data over time.
- **Average (Mean)** – The sum of all values divided by the number of measurements.
- **Variance** – The measure of how much data points differ from the average.
- **Units of Measurement:**
 - **Temperature** – Celsius (°C)
 - **Light Intensity** – Lux (lx)
 - **Soil Moisture** – Percentages (%)

Technology & Programming

- **Components & Hardware:**
 - **Sensor** – A device that detects environmental changes (e.g., temperature, soil moisture).
 - **Actuator** – A component that performs an action based on sensor input (e.g., turning on a fan or pump).
 - **Microcontroller** – A small computer used to control electronic devices (e.g., Micro:bit).
 - **Input/Output** – Signals received (input) or sent (output) by a system (e.g., sensors provide input, motors provide output).
 - **Circuit** – A connected path through which electricity flows.
 - **Prototype** – An early version of a system or device used for testing.
- **Programming Concepts:**
 - **Algorithm** – A step-by-step set of instructions for solving a problem.
 - **Code** – Written commands in a programming language to control a system.
 - **Loop** – A programming structure that repeats a set of instructions.
 - **Condition** – A statement that triggers an action if a certain requirement is met (e.g., “If soil moisture < 30%, activate irrigation”).
 - **Variable** – A stored value in a program that can change (e.g., temperature readings).

Useful grammar structures:

- **Comparatives & Superlatives** (e.g., "Hydroponic farming uses less water than soil-based farming.")
- **Passive Voice** (e.g., "The temperature is measured by sensors every 10 minutes.")
- **Conditionals** (e.g., "If we optimize water usage, we will reduce waste.")
- **Cause-and-Effect Clauses** (e.g., "Because of automation, the greenhouse can maintain optimal conditions.")

Example of a substitution table which can be used:

GRAMMAR TOPIC	EXAMPLE SENTENCE	RELEVANCE TO THE LESSON
Comparatives & Superlatives	"Automated greenhouses are more efficient than traditional ones."	Comparing different greenhouse systems.
Passive Voice	"The humidity is controlled by a sensor."	Describing processes in smart greenhouses.
Conditionals	"If we improve insulation, we will reduce energy loss."	Explaining cause-effect relationships in sustainable agriculture.
Cause-and-Effect Clauses	"Because of increased automation, greenhouses require fewer manual adjustments."	Explaining technological benefits.
Reported Speech	"The report stated that hydroponic farming uses less water."	Summarizing research findings.

Language for learning

Goal

Students will use functional language to **collaborate, discuss, and present their findings** on greenhouse systems and sustainable agriculture.

Objectives

- Use **clarifying and questioning strategies** during group research (e.g., "Could you explain how this system works?").
- Express opinions and justify arguments in **group discussions** (e.g., "I think smart greenhouses are essential for sustainability because...").
- Use **formal and scientific language** to present research findings (e.g., "Our data shows that automated irrigation reduces water consumption by 30%.").

- Apply **planning and problem-solving language** to design and optimize greenhouse systems (e.g., "We should integrate solar panels to reduce energy consumption.").

Functional phrases for research and discussion

- **Asking for clarification:** "Could you explain how this system works?"
- **Expressing opinions:** "I believe that automated greenhouses are better for the environment because..."
- **Agreeing/disagreeing:** "I see your point, but I think manual greenhouses allow more flexibility."
- **Summarizing research:** "Our findings indicate that..."

Functional phrases for campaign planning and presentation

- **Defining objectives:** “Our project aims to design a more energy-efficient greenhouse.”
- **Assigning tasks:** “You will analyze water usage, and I will focus on temperature control.”
- **Explaining technical choices:** “We chose this material because it retains heat better.”
- **Evaluating impact:** “Based on our tests, the system successfully maintains stable humidity levels.”

Language through learning

Goal

Students will develop their language skills dynamically as they engage with new concepts, analyze data, and reflect on their learning.

Objectives

- Record and reflect on **new vocabulary** encountered throughout the project.
- Summarize research findings using **reported speech** (e.g., “The article stated that automated greenhouses improve efficiency.”).
- Evaluate and present data using **scientific analysis language** (e.g., “Our experiment showed a 20% reduction in water use.”).
- Engage in **reflective writing** to describe learning outcomes (e.g., “One key thing I learned from this project is...”).

Strategies to encourage new language development

- **Reflective writing prompts:**
 - “What did you learn about the advantages of smart greenhouses?”
 - “How does this project connect to sustainability in real life?”
- **Student-led discussions:** Encourage students to lead discussions, using newly acquired **technical vocabulary**.
- **Vocabulary log:** Students track **new words** and use them in their reports and presentations.
- **Peer feedback:** Encourage students to **review each other's explanations** for clarity and accuracy.

7. UDL

This unit makes extensive use of Universal Design for Learning (UDL) principles:

- **Multiple means of representation:** Content is delivered through readings, scientific experiments, practical design work, mathematical modelling, digital tools, sensor data, and visual analysis such as graphs and models.
- **Multiple means of action and expression:** Students express their understanding by designing prototypes, programming microcontrollers, collaborating in teams, collecting and interpreting data, creating scale models, and preparing oral and written presentations.
- **Multiple means of engagement:** Motivation is fostered by project-based inquiry, authentic problem solving in sustainability, links to SDGs, collaborative group work, peer feedback, and connections to real-world contexts and careers.

8. MAIN TEACHING METHODOLOGIES

This unit centres on active, integrated STEAM teaching strategies such as Inquiry-Based Learning, Engineering Design Methodology and Coding.

9. ASSESSMENT

Assessment in this unit is carried out continuously and flexibly, adapting to the needs and characteristics of each group. It focuses on both the learning process and the final outcomes, evaluating content mastery, use of the target language, and the development of transversal skills. The following strategies are proposed as general recommendations and can be adapted to suit the specific context of each classroom:

- **Systematic observation:** Teachers monitor student performance throughout the pro-



ject, paying attention to task completion, organization of work, participation in group activities, and the use of English in context. Observation also covers how students engage in scientific reasoning, data logging, and collaborative problem-solving during activities such as photosynthesis experiments, terrarium construction, and greenhouse automation.

- **Rubric-based evaluation of final products:** Rubrics are used to assess prototypes and campaign outputs (e.g., greenhouse models, presentations, reports), focusing on accuracy of content, clarity of communication, creativity, feasibility of solutions, and effective use of L2 (including language accuracy, task-appropriate structures, and subject-specific vocabulary). Rubrics should be shared with students in advance (see Appendix C).
- **Self-assessment:** Students reflect on their own learning, identifying strengths and areas for improvement in collaboration, language use, and technical skills (e.g., programming

sensors, interpreting data). Reflection sheets or digital prompts may support this process (see Appendix D).

- **Peer assessment:** Students evaluate their own participation and that of their teammates using a shared rubric focused on collaboration, commitment, and accountability. This promotes responsibility, empathy, and critical thinking, while ensuring a fair distribution of tasks (see Appendix E).
- **Portfolio assessment:** Students compile a portfolio including research notes, design sketches, data logs, and reflections. This provides evidence of both process and product, supporting formative and summative evaluation.
- **Presentation with Q&A:** Groups present their greenhouse design and automation strategy, explaining choices and linking them to sustainability goals. A Q&A session allows teachers and peers to assess understanding and communication skills.

10. IMPLEMENTATION IN THE CLASSROOM (DESCRIPTION OF THE SEQUENCE OF ACTIVITIES)

In this project, students acquire different knowledge and skills through activities using the book *Luz sees the light*, including the ones related to L2. The activities in this project cover technology and natural sciences and include some content related to mathematics.

We provide some pre-project activities related to the book, so that in the L2 lesson teachers can introduce the book. In this document L2-teachers find different activities related to the book. Using the audiobook can help students.



Language support for the students: Let the students work with this language tool to get language support during the STEAM lessons.

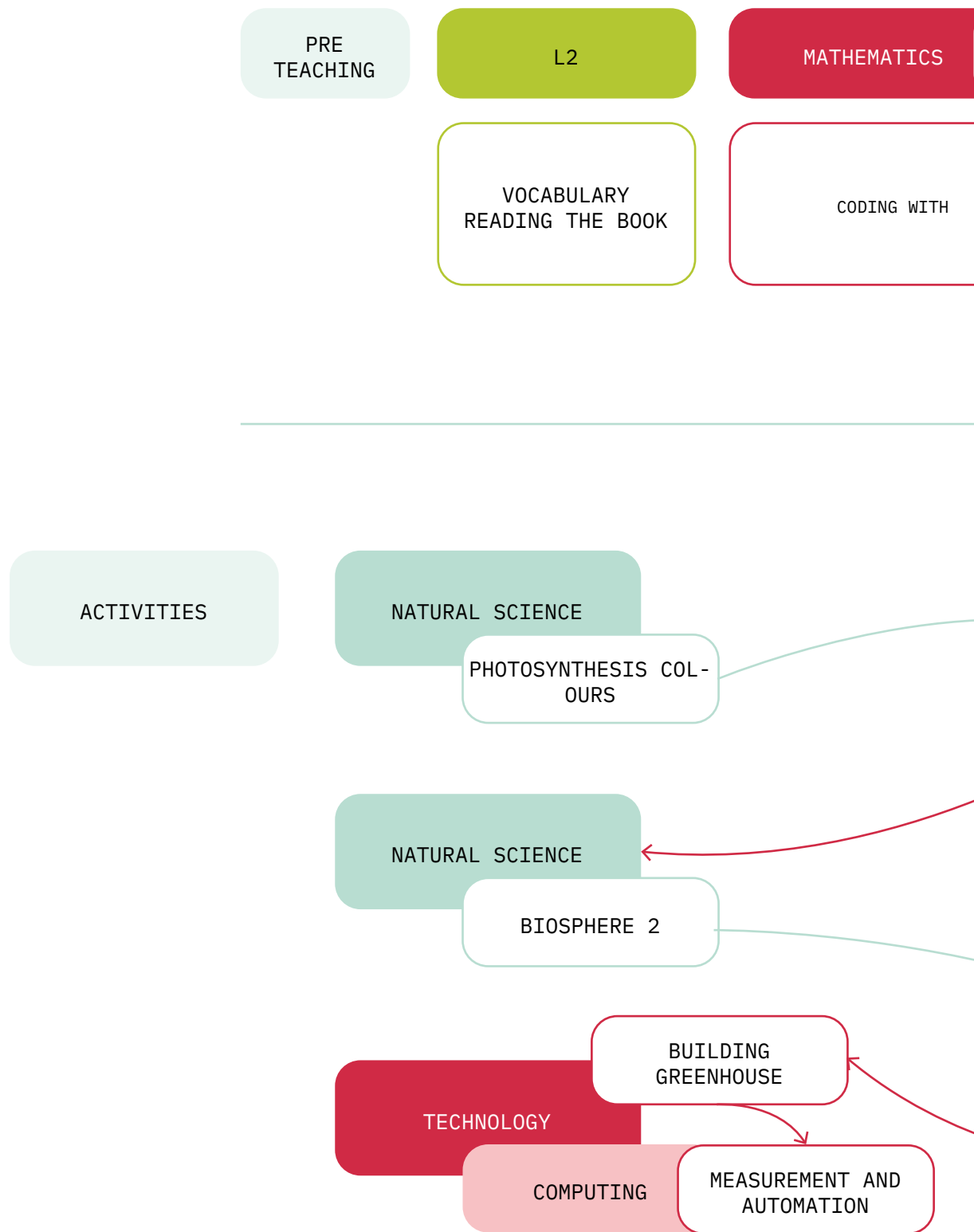
Each of the following activities is introduced by a few suggestions for the L2 teacher. Based on the specific characteristics of the class, the teacher may decide whether or not to use certain resources.

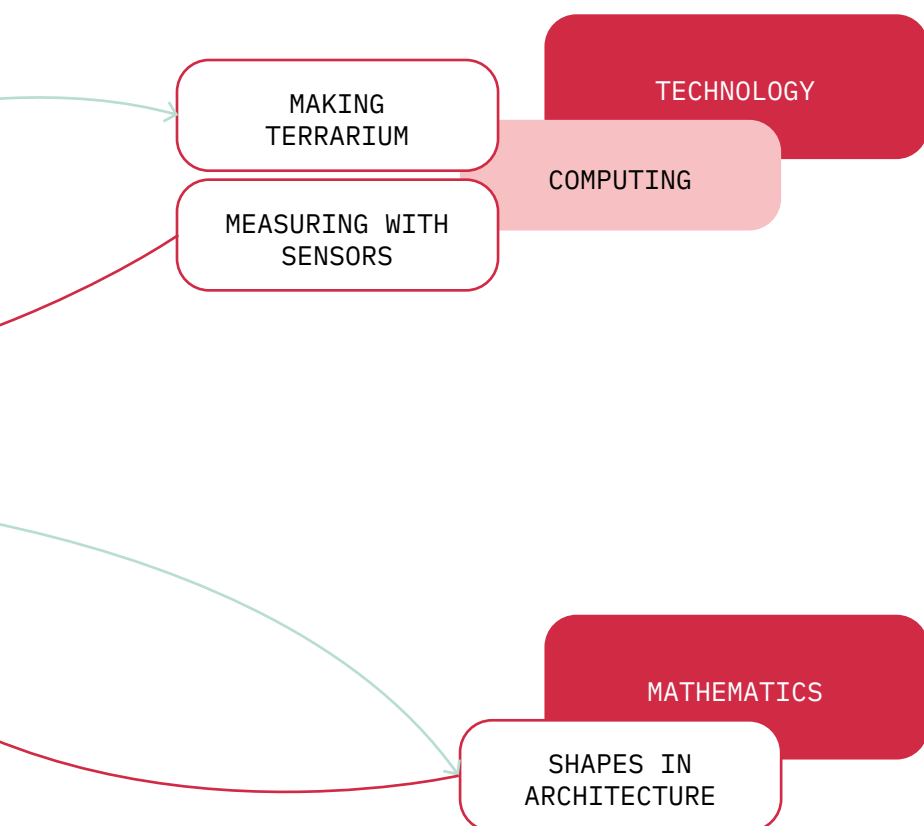
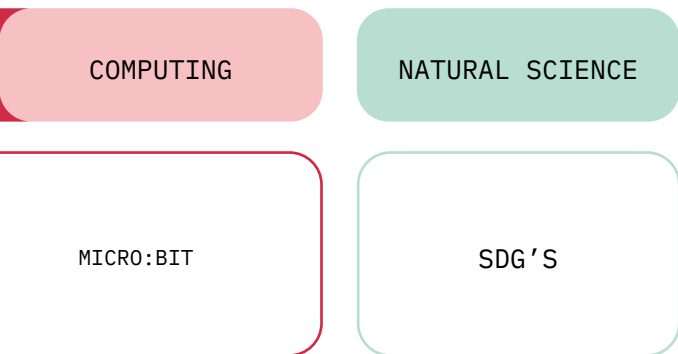
Where certain activities involves previously acquired knowledge, suggestions are provided for additional activities to introduce this knowledge and skills.

Total estimated time: (5 hours – 7 hours)



11. CONCEPT MAP





12.1 PRE-PROJECT ACTIVITIES

30-100'



INTRODUCING THE STORY



Suggestion for L2 teachers: Introduce the book *Luz Sees the Light*.

Use the activities provided in this document to work on the story and vocabulary before starting the science tasks based on the comic narrative, in order to establish the context of the unit.



TIPS
FOR TEACHERS



YOUTUBE AUDIO
VERSION OF THE BOOK



12.2 PROJECT ACTIVITIES

Introduction: Problem statement coming from the narrative “Luz Sees the Light”

Luz tries to mobilize her neighbourhood to start a community garden and make more energy-efficient choices. This ties into building a greenhouse and exploring ways to use energy sustainably.

Goal: Build a self-regulating greenhouse for optimal plant growth.

ACTIVITY 1

PHOTOSYNTHESIS



3-5hs

Suggestion for L2 teachers

What? Support students in using scientific language to describe the process of photosynthesis and in reflecting on their experiment results.

Why? This helps learners explain observations, connect theory and practice, and use the target language for reasoning and reporting.

How?

- Revise key terms from the vocabulary list (e.g., chlorophyll, oxygen, carbon dioxide, light energy).
- Use speaking cards for reflection and group work to structure discussions during the experiment.
- Refer to the Language Support Database for sentence starters in present tense (“Plants absorb...”, “The experiment shows...”) and cause-effect structures.
- Use pictures and let students reconstruct the process of photosynthesis. Interactive hotspot activities, such as this one made with Genially, can help here. Encourage the students to discuss the picture, provide support by means of extra vocabulary and language support.
- Encourage phrases like:
 - “The plant produces oxygen because...”
 - “I observed that when we changed the light intensity...”
 - “Can we compare this result to the theory?”



GENIALLY
IMAGE



VOCABULARY
LIST



SPEAKING
CARDS



LANGUAGE
SUPPORT
DATABASE

Extension / Deepening Opportunity**Broader research challenge:**

"Which type of light is used by leaves to optimize photosynthesis?"

Research Question (with measurable variables):

"What is the influence of the type of light on the amount of starch in the leaves?"

Additional suggestions:

- Students can support their hypothesis by referring to similar experiments (e.g., Engelmann's experiment).
- For an even more engaging approach, consider having students identify and select various factors that could influence photosynthetic activity. This could lead to an alternative research challenge:
- "Which factors influence photosynthesis?"



ENGELMANN'S
EXPERIMENT

1.1 Experiment**30-45'**

In this experiment, students are introduced to the importance of light in the process of photosynthesis. They also learn how different colours affect photosynthesis.

Materials

Plants (e.g. bean plants), coloured transparent foil (red, blue and green), lamp, aluminium foil, scissors, iodine solution, water and pipette.

Preparation

Divide the students into small groups, give each group a plant, aluminium foil and coloured foil.

Experiment

Have students cover different parts of their plant's leaves with coloured foil (red, blue, green) and one part with aluminium foil (control).

Place the plants under a lamp and leave them there for several days. Make sure the lamp is on for a few hours every day.

Observation

After a few days: remove the foil, boil the leaves in water (to kill them) and then dip them in the iodine solution.

Ask students to describe what they see:

- the parts of the leaf exposed to light will turn blue-black due to the presence of starch
- compare the colour intensity of the different parts to see which light was most effective for photosynthesis



1.2 Theory of photosynthesis and importance of light 15-20'

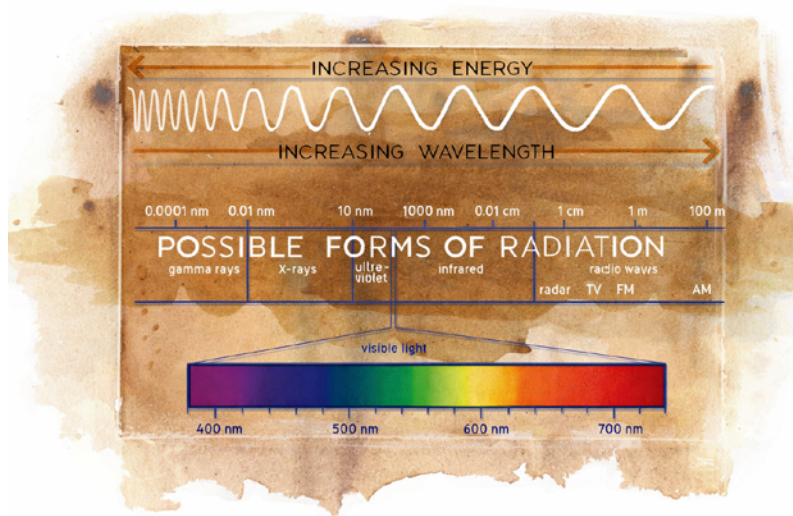


PHOTOSYNTHESIS
PRESENTATION

The principle of light and its spectrum

What is light?

Light is a form of electromagnetic radiation consisting of waves of different wavelengths. The visible light spectrum for humans is between 400 and 700 nanometres (nm) and is also called Photosynthetically Active Radiation (PAR) (1). It is important to note that visible light is only one part of the electromagnetic spectrum, which also includes other types of radiation such as ultraviolet (UV), infrared (IR), radio waves, microwaves, X-rays, and gamma rays.



(source 1) Image 1: Light, in the form of electromagnetic waves, is described by the electromagnetic spectrum. The most important element that light can offer plants is the wavelength or amount of energy; the shorter the wavelength, the more energy.

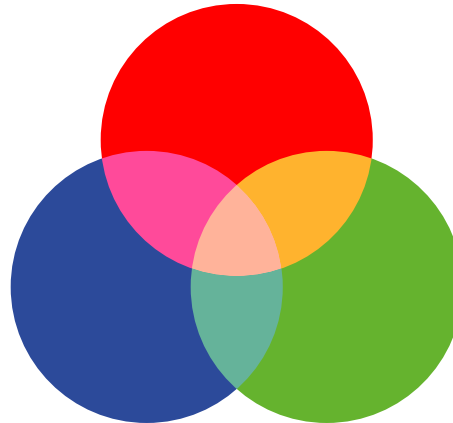
Plants use light to grow through photosynthesis, but they do not absorb all colours of the visible spectrum.

White light can be split into seven colours (red, orange, yellow, green, blue, indigo, and violet), but plants primarily absorb red and blue light for energy.

This is due to pigments in the leaves, such as chlorophyll. Chlorophyll absorbs mostly red and blue light but reflects green light, which is why leaves appear green to us!

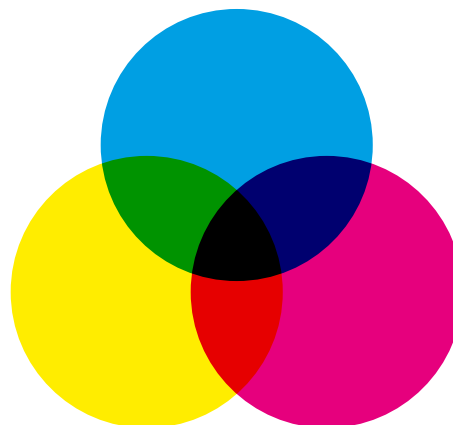
To better understand colours, we can look at the RGB and CMY colour models.

The **RGB** model (red, green, blue) is an additive colour model used for light, such as on computer screens. When red, green, and blue light are combined at full intensity, they create white light.



CMY model (cyan, magenta, yellow) is a subtractive colour model used in printing and pigments. It works by absorbing (subtracting) certain wavelengths of light and reflecting others.

Plant pigments behave similarly to the subtractive model: they absorb specific colours and reflect others. Since chlorophyll absorbs mainly red and blue (which means it absorbs less cyan and magenta), it reflects green light.



Sources: (1) <https://www.canna.nl/articles/het-effect-van-het-lichtspectrum-op-de-ontwikkeling-van-planten> (2) Hewitt, P. G., Lyons, S. A., Suchocki, J. A., & Yeh, J. (2024). *Conceptual Integrated Science* (3e editie). Pearson

Ask students to connect the information from this text to the experiment they did earlier on photosynthesis.

By experimenting with different light colours in photosynthesis, we can see that plants grow well under red and blue light but much less effectively under green light. This explains why most plants have green leaves!

EXTRAS

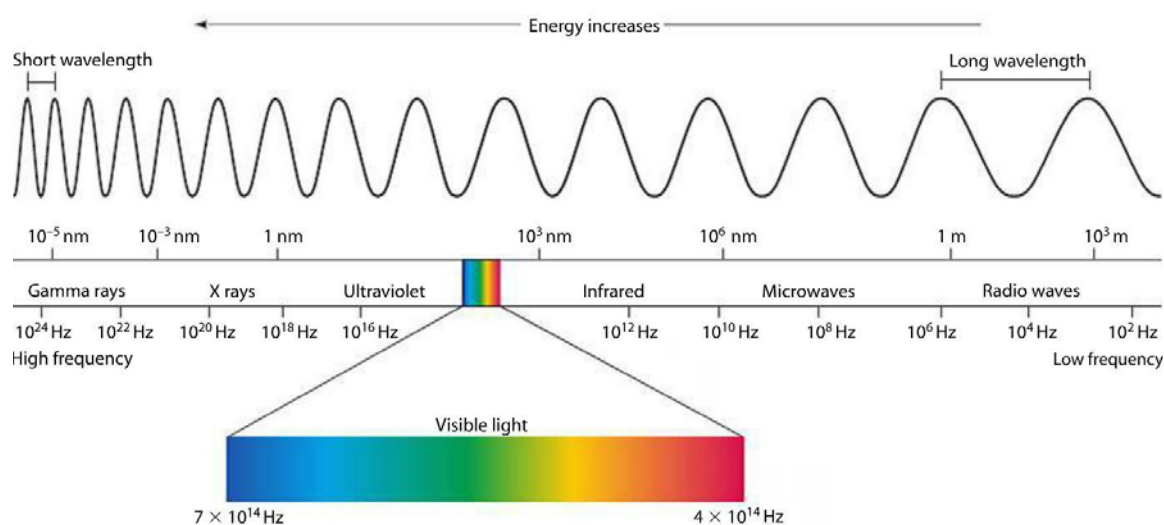
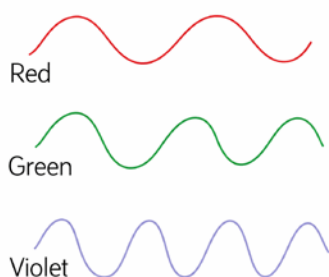


Figure 1: The electromagnetic spectrum is a continuous range of electromagnetic waves extending from radio waves to gamma rays. The descriptive names of the sections are merely a historical classification, for all the waves are the same in nature, differing principally in frequency and wavelength; all travel at the same speed.

The lowest frequency of light we can see with our eyes appears red. The highest visible frequencies, which are nearly twice the frequency of red light, appear violet. Still higher frequencies are ultraviolet. These higher-frequency waves are more energetic and can cause sunburns. Beyond ultraviolet light are the X-ray and gamma-ray regions. There is no sharp boundary between regions of the spectrum, for they actually grade continuously into one another. The spectrum is divided into these arbitrary regions for the sake of classification.



Source: Hewitt, P. G., Lyons, S. A., Suchocki, J. A., & Yeh, J. (2024). *Conceptual Integrated Science* (3e editie). Pearson

Extra activity: Refraction of Light with a Glass of Water

What does it demonstrate?

Light consists of different colours and can be refracted.

Materials

- A glass of water
- A white flashlight or sunlight
- A white surface (paper or wall)

Procedure

- Fill a glass with water and place it on the edge of a table.
- Shine a beam of light through the glass onto a white surface.
- Observe how the light bends and sometimes creates a rainbow effect.

Explanation

White light is made up of different colours. When it passes through water, it slows down and bends (refraction), sometimes revealing the colours of the spectrum.



Suggestion for L2 teachers

What? Guide students in using precise, technical language to describe how they build a terrarium and interpret sensor data.

Why? This supports learners in explaining procedures, reporting measurements, and making data-based conclusions in English.

How?

- Revise key terms from the vocabulary list (e.g., humidity, temperature, sensor, data).
- Use role cards to structure group tasks (e.g., the scribe records data, the helper sets up sensors).
- Encourage use of speaking cards for presenting findings and reflecting on challenges.
- Refer to the Language Support Database for comparatives ("higher/lower than...") and conditionals ("If the humidity increases, then...").
- Encourage phrases like:
 - "We installed the sensor by..."
 - "The readings show that the terrarium is too dry/wet because..."
 - "What happens if we change the light source?"



VOCABULARY
LIST



SPEAKING
CARDS



ROLE
CARDS



LANGUAGE
SUPPORT
DATABASE

TIPS
FOR TEACHERS

Extra: make students draw their own graphic of the terrarium water cycle.

2.1. Students create their own terrarium in groups to learn about the water cycle. The terrarium is used for experiments in a subsequent activity.

20-30'

Materials

- glass pots
- soil
- plants
- water
- plastic foil



INTERACTIVE
PICTURE

Using the interactive picture, explain to the students what a terrarium is.

Encourage the students to try to answer the guiding questions included in the interactive picture (genially):

- How does this water cycle compare to a normal water cycle?
- Why is it important that the soil has the right amount of water?
- Why can it help to have insects living in your terrarium?

Instructional video on the water cycle and making a terrarium.



2.2. Students programme and use sensors to measure temperature, soil moisture and light intensity and log the results of their experiments 30-40'

Materials

- terrarium
- micro:bit
- temperature sensor
- moisture sensor and light sensor



THERMOMETRE



LIGHT SENSOR

Explain to the students that by opening the terrarium to take measurements, it is no longer a closed system, and the natural conditions are temporarily disrupted. However, the goal is to use these sensors to monitor key parameters – just as we will later do in a greenhouse, which is also not a completely closed system.

Have students measure with their micro:bit in different conditions:

- Leave terrarium dry (or just measure dry soil somewhere)
- When a lot of water has been added to the terrarium
- When terrarium is in the sun or under lamp
- When terrarium is put in fridge
- Covered terrarium with dark cloth
- ...

Have students log their data:



ON PAPER: DOWNLOAD AND ADJUST THE FORM + ADD THE UNITS



OR DIGITALLY

A micro:bit v2 has a built-in thermometer and light sensor. A humidity metre can be added or made yourself.

Instruction to make a moisture sensor: https://www.youtube.com/watch?v=S8Np-pVT_paw

Let the students make their own suggestions for experimenting with their terrarium. The aim here is purely to learn how to use the micro:bit and sensors and how to log the data.

Explain to the students that by opening the terrarium to take measurements, it is no longer a closed system, and the natural conditions are temporarily disrupted. However, the goal is to use these sensors to monitor key parameters – just as we will later do in a greenhouse, which is also not a completely closed system.

Recommending that students log digitally. This will still be used at a later stage when building a smart greenhouse.

Allow for a little more time if this is the first time for pupils so that they can master data logging.

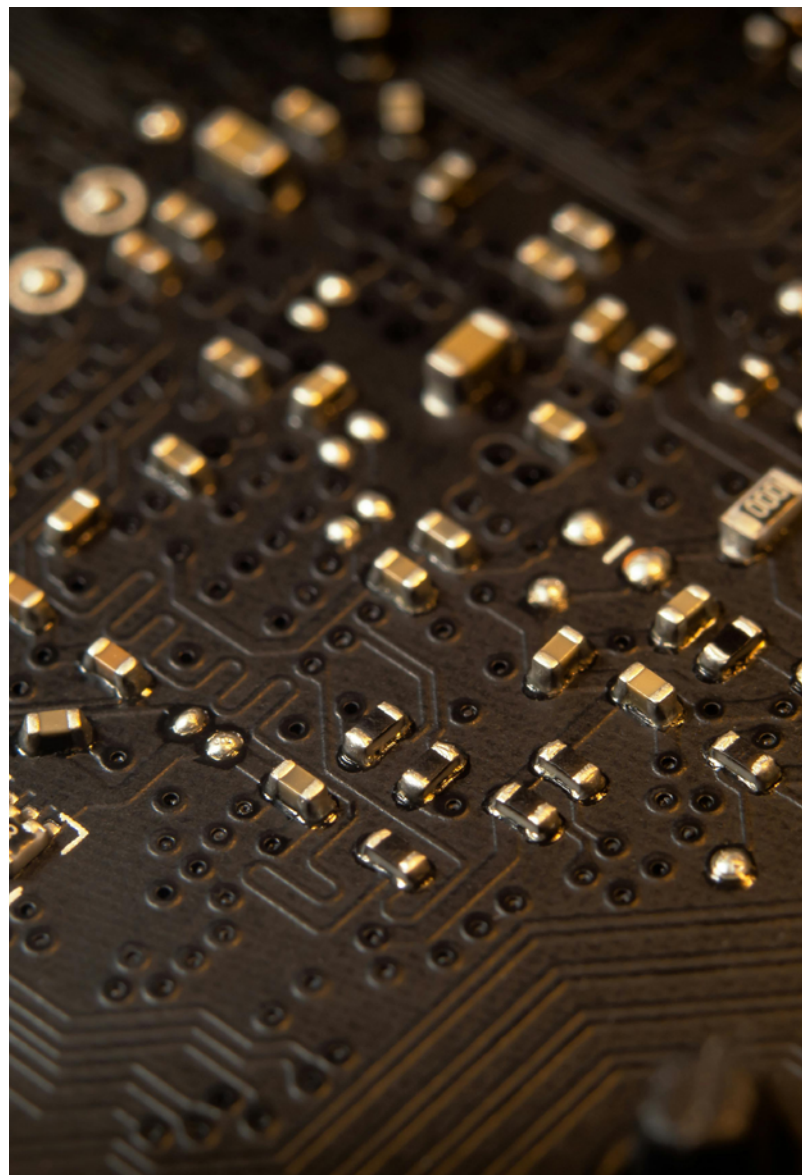
2.3. Reflection

On the activity

- What did you find the most fun or surprising about working with the micro:bit?
- Which sensor did you find most interesting and why?
- What went well in programming and logging? What did you find more challenging?

On the importance of sensors and data

- Why is it useful to measure and store data automatically instead of recording everything by hand?
- Where else are sensors and data logging used in daily life? (Think of weather stations, cars, smartwatches, greenhouses, etc.)
- How could you use the micro:bit and sensors to help a plant grow healthier?



ACTIVITY 3

CAN HUMANS SURVIVE IN A TERRARIUM?
(BIOSPHERE2)



30-45'

Introduce this section by referring to the contents of a terrarium.

Show pictures of different types of terrariums (with insects and animals):



INTERACTIVE
IMAGE



Source photo: Richard Myer



TIPS FOR
TEACHERS

In pairs is a grouping form that encourages communication skills.



VIRTUAL TRIP
(WITH SUBTITLES)

Ask the pupils: Considering in a small terrarium insects and small animals can survive... could humans also survive in a closed ecosystem or a large terrarium?

Have students share their ideas on this. Perhaps some pupils have already heard of Biosphere2.

Use this picture to introduce Biosphere2:



Let pupils read this text in order to let them answer the following questions/selection of the questions:

Important tip: make sure students know in advance what to look for when reading so give them a focus. (Give the questions to students in advance).

About the text:

- What was the goal of the Biosphere 2 experiment?
- What challenges did the scientists face inside Biosphere 2? Name at least two.
- What were the main ecosystems simulated in Biosphere 2?
- What lessons were learned from the experiment? Do you think the experiment was successful? Why (not)?

About previous knowledge:

- How is Biosphere 2 similar to a terrarium? How is it different?
- In what way does the water cycle play a role in Biosphere 2?
- Why was photosynthesis essential for the survival of people inside Biosphere 2?

About usefulness for science and mankind:

- Do you think Biosphere 2 was a useful experiment? Why or why not?
- Imagine a similar experiment were conducted today. What would you do differently?
- Can such experiments help us in the fight against climate change?

Biosphere 2: A Bold Experiment in Self-Sufficiency

In the early 1990s, scientists launched an ambitious experiment in the Arizona desert: Biosphere 2. This enormous glass and steel structure was designed as a completely closed ecological system, mimicking Earth's natural processes on a smaller scale. Researchers hoped to test whether humans could survive in a self-sustaining environment, relying only on the resources produced within the system. The project was also seen as a potential model for future space colonization.

Inside **Biosphere 2**, various ecosystems were recreated, including a rainforest, an ocean with a coral reef, a desert, a savanna, and wetlands. Agricultural areas were also included, as the eight participants – known as “Biospherians” – had to grow their own food and manage water, air, and waste recycling without outside assistance. The goal was to replicate Earth's fundamental life-support systems, relying on the natural cycles of oxygen, carbon, and water to sustain both plant and human life.

However, the experiment quickly encountered **significant challenges**. Oxygen levels dropped unexpectedly, requiring external intervention to prevent suffocation. Food production proved insufficient, and the team experienced malnutrition. Some species introduced for pollination died out, while others, such as cockroaches and ants, thrived uncontrollably. Psychological tensions arose as the group struggled with isolation and the pressures of maintaining balance in the artificial environment.

Despite these setbacks, Biosphere 2 provided **valuable scientific insights**. It revealed the delicate interdependence of ecosystems and the difficulty of replicating Earth's processes in a controlled setting. Researchers learned how minor imbalances – such as soil absorbing more oxygen than anticipated – could have major consequences. The project also highlighted the importance of biodiversity and ecosystem resilience in maintaining a habitable environment.

Today, Biosphere 2 serves as a research facility for climate science, helping scientists study the effects of rising temperatures and changing atmospheric conditions. Although the original mission did not achieve full self-sufficiency, it raised essential questions about sustainability and human survival beyond Earth. The experiment demonstrated both the complexity of ecological systems and the challenges of designing self-contained habitats.

As efforts to develop sustainable architecture and space exploration continue, Biosphere 2 remains a fascinating case study in human ingenuity and environmental science. It forces us to consider: Can we truly recreate Earth's balance in a closed system? And if not, what does that say about our responsibility to protect the planet we already inhabit?

This resource contains annotated words with the meaning and pronunciation.



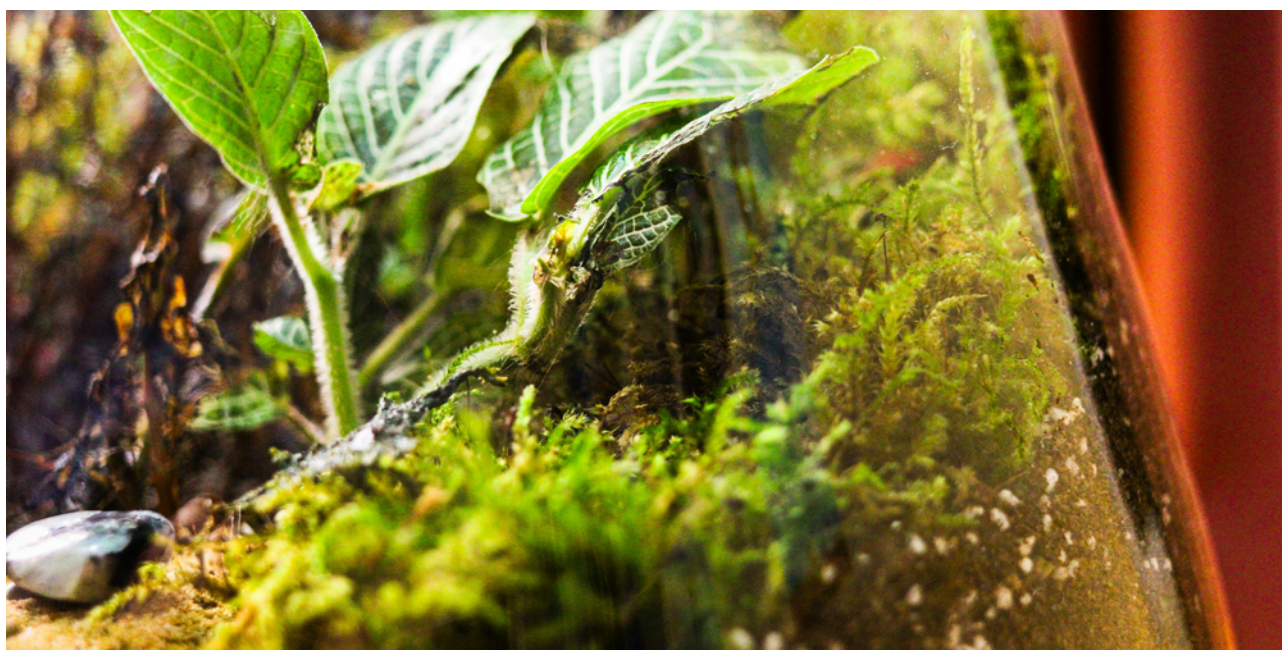
SOURCE:
BIOSPHERE 2



SOURCE:
WIKIPEDIA



SOURCE:
BRITANNICA



Alternative text (easier):

Biosphere 2: A Scientific Experiment in a Closed World

In the early 1990s, a unique scientific experiment called Biosphere 2 was conducted in Arizona, USA. Scientists wanted to test whether humans could live in a completely closed environment, relying only on the air, water, and food produced within the system. The goal was to create a self-sustaining world, much like Earth – also known as **Biosphere 1** – but on a smaller scale. This research was important not only for understanding ecosystems on Earth but also for exploring the possibility of humans living in space, for example, on Mars.

The Design of Biosphere 2

Biosphere 2 was a massive glass and steel structure covering 1.27 hectares. Inside, scientists recreated different natural ecosystems, including:

- A **rainforest** with tropical plants and high humidity.
- A **desert** with dry conditions and drought-resistant plants.
- A **savanna**, resembling African grasslands.
- A **wetland** marsh, which helped regulate water and air quality.
- An **ocean** with a coral reef, imitating a marine environment.
- **Farmland**, where crops were grown for food.

Eight scientists, known as “Biospherians,” lived inside Biosphere 2 for two years (1991-1993). They had to grow their own food, recycle water, and maintain oxygen levels. There was no physical contact with the outside world, and nothing (except sunlight) could enter or leave the system.

How Did Biosphere 2 Work?

Just like on Earth, Biosphere 2 depended on key **natural cycles**:

- **The Water Cycle:** Water evaporated, condensed, and fell as rain inside the structure.
- **Photosynthesis:** Plants absorbed carbon dioxide and released oxygen, providing air for the Biospherians to breathe.
- **Nutrient Cycling:** Dead plants and waste materials decomposed, enriching the soil for new plant growth.

These processes were necessary to keep the environment stable and support life.

Challenges and Problems

Despite careful planning, Biosphere 2 faced **several problems**:

- **Oxygen Levels Dropped:** Scientists discovered that oxygen was being absorbed by the soil and concrete, leading to dangerously low levels. After 16 months, extra oxygen had to be pumped in from the outside.
- **Food Was Scarce:** The crops did not produce enough food, and the Biospherians lost a lot of weight.

- ***Some Species Died, Others Took Over:*** Many pollinating insects died, while cockroaches and ants multiplied uncontrollably.
- ***Psychological Stress:*** The team faced conflicts and stress due to the difficult living conditions and isolation.

What Did Scientists Learn?

Even though Biosphere 2 did not work exactly as planned, scientists gained valuable insights about ecosystems, climate change, and sustainable agriculture. They realized how complex and delicate the balance of an ecosystem is and how small changes can have big consequences. Today, Biosphere 2 is still used for research, helping scientists study the effects of climate change and how humans might survive in space colonies.

Thinking About the Future

The challenges of Biosphere 2 raise important questions:

- Could we create a successful self-sustaining environment for humans on another planet?
- What lessons from Biosphere 2 can we apply to making greenhouses and cities more sustainable?
- If you were to design your own closed ecosystem, what elements would you include?

Biosphere 2 was an ambitious experiment that taught us how fragile and interconnected life on Earth really is. What would you do differently if you had the chance to build your own self-sustaining world?



Suggestion for L2 teachers

What? Support students in using mathematical and architectural vocabulary to design and analyze shapes and volumes.

Why? This allows learners to discuss geometric properties, justify design choices, and evaluate efficiency in English.

How?

- Revise key terms from the vocabulary list (e.g., cube, prism, volume, surface area, efficiency).
- Use speaking cards to structure group discussions and reflection.
- Assign role cards so students practice language while taking responsibility (e.g., the spy checks other groups' constructions and reports back).
- Use the Language Support Database for sentence starters in comparison ("This shape is more efficient than...") and problem-solving structures.
- Encourage phrases like:
 - "The volume of this figure is larger/smaller than..."
 - "If we combine these shapes, we can create..."
 - "Which figure is most efficient for our greenhouse design?"



VOCABULARY
LIST



SPEAKING
CARDS



ROLE
CARDS



LANGUAGE
SUPPORT
DATABASE

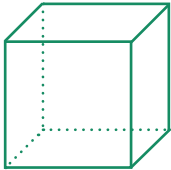
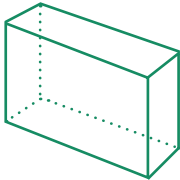
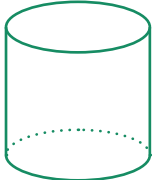
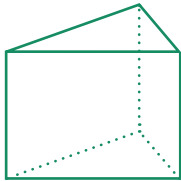
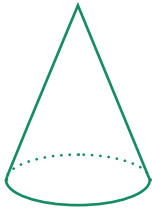
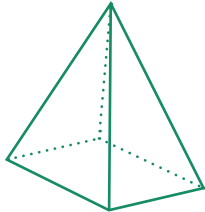
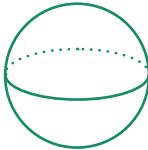
In this activity, solid shapes and their properties are repeated and students create a solid shape using unfolding. Volume is also calculated.

Understanding 2D and solid shapes is essential for designing and constructing objects in real life. In this project, students explore how flat shapes (2D) can be transformed into 3D structures, which directly connects to the later goal of building a functional greenhouse.

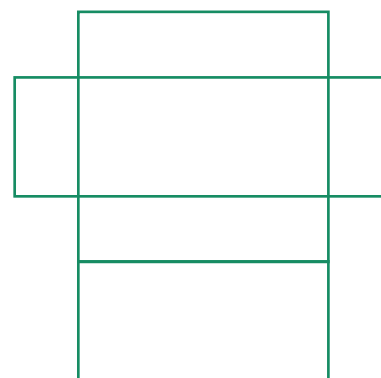
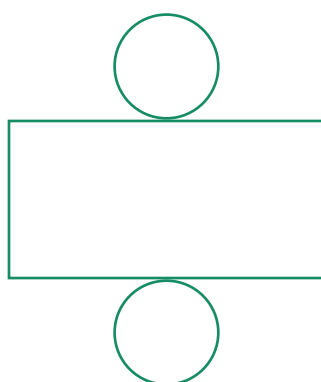
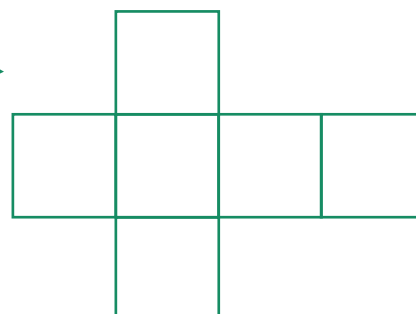
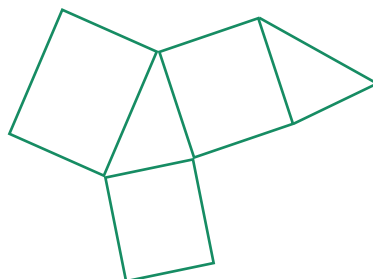
Students analyse different volumes to determine the most efficient shape for their greenhouse. This helps them understand how shape influences structural stability and internal space, preparing them for the next step of designing their prototype.

Preparation

- Teacher makes one envelope per group of maximum 3 students with yellow, one envelope with green, one envelope with red and one envelope with blue cards. The yellow cards show a picture of a solid shape, the green cards show its name, the red cards show its properties and the blue cards show formulae for calculating its volume.

YELLOW	GREEN	RED	BLUE
	Cube	- Has 8 vertices - Has 3 groups of parallel edges - All edges are of equal length - All faces are squares - Four space diagonals bisect each other	$V = A_g \cdot h = z^3$
	Cuboid	- Has 8 vertices - Has 3 groups of parallel edges - All faces are a combination of squares and rectangles - Four space diagonals bisect each other	$V = A_g \cdot h = b \cdot l \cdot h$
	Cylinder	- The top and bottom faces are circles - The curved surface is a rectangle when unfolded	$V = A_g \cdot h = \pi \cdot r^2 \cdot h$
	Prism	- The base and top faces have the same shape - The remaining faces are rectangles - The number of vertices, edges, and faces depends on the shape of the base	$V = A_g \cdot h$
	Cone	- The base is a circle - The curved surface is a sector of a circle - Has one apex	$V = \frac{1}{3} \cdot \pi \cdot r^2 \cdot h$
	Pyramid	- Has one base - Has one apex - Has sloping faces - The number of vertices, edges, and faces depends on the shape of the base	$V = \frac{1}{3} \cdot A_g \cdot h$
	Sphere	- No vertices or edges - Consists of a single curved surface	$V = \frac{4}{3} \cdot \pi \cdot r^3$

- b. Teacher makes x number of envelopes, each containing 1 of the unfoldings below. X = number of groups of maximum 3 pupils. 1 unfolding on an A4 paper so that the solid shapes are large enough.



TIPS
FOR TEACHERS

Extra:

ICT: Using a computer programme, draw the unfolds in large format by multiplying each distance by 10, so that they can be used as greenhouse.

4.1. Introduction

5'

Show the picture of Biosphere2 again and ask students if there is anything that strikes them about the building?

Shapes!

Tell the students that later they will be constructing a greenhouse, which will be made up of flat shapes combined to form a 3D shape.



4.2. Investigating the difference between polyhedral and non-polyhedral 5'

The teacher hands out one envelope with yellow cards to each group.

Task:

- Carefully examine the 3D shapes.
- Divide the shapes into two groups:
 - **Which shapes consist only of polygons?**
 - Place these in the **polyhedral** group.
 - **Which shapes contain at least one curved surface?**
 - Place these in the **non-polyhedral** group.
- **Verification and discussion.**

4.3. Investigating the Properties of 3D Shape 10'

The teacher hands out one envelope with red, one with green, and one with blue cards to each group.

Task:

- Assign the correct **name** to each shape (red card).
- Assign the correct **properties** to each shape (green card).
- Assign the correct **formulas** to each shape (blue card).

4.4. Relationship Between Nets and 3D Shapes 10'

The teacher hands out one net to each group.

Task:

- Match the correct set of cards (yellow, red, green, and blue) to the given net.
- Cut out the net and fold it into the corresponding 3D shape.

4.5. Volume calculation 10'

Task:

- Use the formulas to calculate the volume of your shape.
- Each group moves one table to check the calculations and final results of another group.

Stronger groups can take on an extra challenge during/after they build their own greenhouse (activity 6)

Investigating similarity and the similarity ratio:

The similarity ratio allows students to compare their scaled paper model to the actual greenhouse they will build/built. By calculating this ratio, they understand proportional reasoning, a key concept in engineering and design. It also ensures that their final greenhouse dimensions are realistic and functional.

- Calculate the similarity ratio between an edge of your own greenhouse and an edge of the paper model.
- Calculate the similarity ratio between the area of the base of your own greenhouse and the area of the base of the paper model.
- Calculate the similarity ratio between the volume of your own greenhouse and the volume of the paper model

For **similar figures**, the following mathematical relationships apply:

Scale factor for lengths

The **similarity ratio** (scale factor) for a length, such as a side, height, or radius, is calculated as:

$$r = \frac{\text{largest length}}{\text{smallest length}}$$

Here, ***r*** is the factor by which you multiply the smallest length to obtain the largest length.

Scale factor for areas

The relationship between the areas of similar figures is equal to the square of the **similarity ratio**:

$$r^2 = \frac{\text{largest area}}{\text{smallest area}}$$

Scale factor for volumes

For similar figures, the ratio of their volumes is equal to:

$$r^3 = \frac{\text{largest volume}}{\text{smallest volume}}$$

Important Note

These formulas apply **only** to similar figures. This means that in a scaling transformation, **all corresponding lengths** must have the same scale factor (**similarity ratio**).



ACTIVITY 5

BUILD YOUR OWN GREENHOUSE



2-4HS

In this activity, students will work with solid shapes to create a greenhouse, test it for a number of features and finally automate it to arrive at ideal conditions for plants to grow.

First, students make a scale design to investigate properly, and then they make their final greenhouse in groups.

Suggestion for L2 teachers

What? Support students in using technical and problem-solving language while designing, building, and automating a greenhouse.

Why? This helps learners express design steps, test features, and reflect on how sensors and motors improve plant growth conditions.

How?

- Revise key terms from the vocabulary list (e.g., automation, sensor, motor, ideal conditions, prototype).
- Use speaking cards (presenting and reflecting) to help students report on their scale design and final prototype.
- Refer to the Language Support Database for sentence starters in future tense ("We will test...", "The system will improve when...") and conditionals.
- Encourage phrases like:
 - "Our design includes sensors to measure..."
 - "The motor will start if the temperature reaches..."
 - "Let's test the greenhouse to see if it keeps the right conditions."



VOCABULARY
LIST



SPEAKING
CARDS



LANGUAGE
SUPPORT
DATABASE

Materials for scaled prototype

- Paper and pencils
- Rulers and geodesics
- Cardboard or sturdy paper
- Scissors and glue
- Tape measure
- Software for 3D modelling (optional)

Materials for the final greenhouse

Structural Materials:

- Wooden sticks, popsicle sticks, or dowels (for the frame)
- Cardboard or foam board (for structural support)
- Plastic sheets, transparent acrylic, or clear plastic wrap (for windows and covering)

Alternative/expansion:

- Invite a professional in whose profession geometry plays an important role as guest speaker.
- Have students interview a professional in whose profession geometry plays an important role.



PROFESSIONS
AND INTERVIEW
TEMPLATE

In L2 support, the role cards and speaking cards can be used (select the roles to be covered during this consultation).

- Wire or string (to reinforce the frame)
- Glue gun and glue sticks (for assembling parts)
- Tape (duct tape, masking tape, or transparent tape)
- Scissors and utility knives (for cutting materials)

Fastening & Support:

- Small nails or screws (if using wooden materials)
- Clips or binder clips (for holding plastic coverings in place)
- Rulers and measuring tapes (for precision)

Environmental & Functional Materials:

- Small plant pots or soil containers
- Soil and seeds (optional for realistic testing)
- Coloured cellophane or plastic sheets (for testing the effect of different light colours)

5.1. Explain the requirements for the final greenhouse (without sensors & motors)

Size constraints:

- Minimum Dimensions: 20 cm (L) × 20 cm (W) × 25 cm (H)
- Maximum Dimensions: 50 cm (L) × 50 cm (W) × 60 cm (H)

Structural requirements:

- The greenhouse must have a solid frame that can support the covering material.
- At least one transparent side to allow sunlight to enter.
- Must include a door or an opening to allow access for plant maintenance (e.g. irrigation)
- The greenhouse should have a ventilation option (can be manually operated for now).
- Should be stable and self-standing without additional external support.

5.2. Greenhouse design and paper prototyping

Goal: To understand which solid shapes are most suitable for a greenhouse and why.

Begin with a brief *review* of the theory of plane shapes and solid shapes, and how plane shapes can be combined to form solid shapes (Activity 5).

Explain to the students the importance of solid shapes in design & technology.

To help students understand how solid shapes are used in re-

al-world designs, you can ask them to give some examples of jobs where geometry plays an important role.

Or you can show them images related to this jobs and ask them to make the connection to solid shapes.

Some examples: architect, industrial designer, engineer, product packaging designer, horticulturist or agricultural engineer....

Brainstorm

Divide the class into small groups.

- Have students sketching different greenhouse designs using various solid shapes such as cubes, prisms, and pyramids.
 - This can be supported with the template from Lesson Plan 1 (brain sketching).
- During this activity, students discuss the advantages and disadvantages of each design. Encourage them to compare different designs based on stability, space efficiency, and aesthetics. For example, a pyramid-shaped greenhouse may be better for water drainage, while a cube-shaped greenhouse provides more space.

By the end of this activity, each group should have a clear idea of how their greenhouse should look. (50 – 60 min)

Creating a paper model is a necessary bridge between the mathematical design phase and the construction of the mini-greenhouse. It allows students to test different shapes, analyse stability, and refine their design before committing to more permanent materials. This step minimizes errors, improves their engineering skills, and ensures a smoother transition to automation with the micro:bit

Prototyping

- Have students turn their designs into scale models using cardboard or sturdy paper.
- They can cut out plane shapes and assemble them into solid shapes or use the unfolded shapes they worked with in a previous activity.

Presentation and evaluation prototypes

Each group presents their findings (choices made and the reason why).

The teacher ensures that the following issues are covered within the discussion of the different greenhouses:* (crosscutting concept: structure and function)

Extra 3D Modelling:

Having access to computers and 3D modelling software (such as Tinkercad) allows students to create and analyse their designs digitally. This can help them gain a better understanding of geometric principles and their practical applications.

Explain explicitly what the crosscutting concept of structure and function means.

Explain explicitly what the crosscutting concept of systems and system models means.

Suggested extension / Deepening opportunity:

Investigate the relationship between greenhouse parameters and plant growth. For example, you could set up an experiment using two identical greenhouses where the dependent variables (e.g., average growth length or growth rate) are measured, while the parameters mentioned above serve as independent variables. This approach would allow for controlled testing of how these variables affect plant development.

- **The properties of different solid shapes** and how they can be used in greenhouse design (refer to the lesson on **Biosphere 2**).
- **How the shape of a greenhouse affects stability.** For example, a pyramid-shaped greenhouse may be more stable in windy conditions.
- **How the shape of the greenhouse affects the amount of usable space.** For example, a cube-shaped greenhouse provides more internal space than a pyramid-shaped greenhouse of the same height and base area.

Tip: repeat the requirements for the final greenhouse before students start building the greenhouse.

5.3 Building the final greenhouse**50-80'**

- Students decide how they will modify the prototype to achieve a better design.
- Have students draw up a schedule, with a division of labour within the group.
- They then convert their prototype into the final greenhouse with more robust materials (which they can optimise afterwards).

5.4 Greenhouse as a system***20-30'**

Ask students what things are important for plants to grow? (*Crosscutting concept: systems and system models*)

Perhaps students will list more than the parameters we are going to manipulate, explain to them that we are going to optimise the following things in their greenhouse:

- soil moisture
- temperature (environment)
- light intensity

We will limit ourselves to these three parameters because we have worked with these sensors before and we cannot cover everything in one project.

- Discuss with students how a greenhouse consists of different subsystems, such as the structure, temperature control and water management.
- Get them to think about how these parts work together to optimise plant growth.

Also explain to the students that it might be necessary to make some further (limited) adjustments to their design of their conservatory, during this phase and that this is allowed.

Give students the threshold values and additional info on the three parameters, or have them look up what they are. Explain why we need these values.

5.5 Making the greenhouse smart

50-100'

Materials:

- Servo motors
- Grove shield
- Water pump
- Led light
- ...

For automating the greenhouse using a **micro:bit**, you can follow these steps:

- **Controlling Motors**
 - Use a servo motor or DC motor to open and close doors or windows. Connect the motor to the micro:bit using a grove shield.
 - Program the micro:bit to control the motor based on **temperature sensor data**. For example, if the temperature rises above a certain threshold, the motor will open the door or window.
- **Automating Lighting**
 - Connect an LED light to the micro:bit using a relay module.
 - Program the micro:bit to turn the light on when the light sensor detects that it is too dark.
- **Automating Irrigation**
 - Use a water pump controlled by the micro:bit via a relay module.
 - Program the micro:bit to activate the pump when the moisture sensor detects that the soil is too dry.



HOW TO SET
UP A
SERVOMOTOR?



HOW DOES
RELAY WORK?



INFORMATION
AND A CODE
EXAMPLE

5.6 Concluding Reflection

15-30'

- Discuss with students what has been covered during previous lessons
- Encourage students to name the crosscutting concepts and the STEAM skills
- Ask explicitly about the link with the book Luz sees the Light.
- Have students explain the links between the content and the book in simple sentences.

First let students test their sensors and automation without being connected to the greenhouse. Instruction video's.

Depending on the experience of the students and teacher, more or fewer things can be automated.



EXAMPLES

Setup_relay

How to use a relay with an micro:bit and a grove shield?



Using a relay with micro:bit and the Keyestudio Sensor Shield V2.



LINKS BETWEEN THE
BOOK AND THE
ACTIVITIES



PROJECT ASSESSMENT

Content (see rubric appendices)

Possible evaluation methods:

- **Individual reflection report:** Students write a personal report reflecting on their learning process and campaign impact.
- **Peer Review:** Students assess each other's work using a simplified version of the rubric.
- **Presentation with Q&A:** Students present their campaign and justify their choices before a jury (e.g., teachers, external experts, classmates).
- **Portfolio Assessment:** A collection of their research, analyses, campaign plans, and reflections is evaluated.
- **Teacher Observation & Assessment:** During campaign execution, the teacher evaluates message effectiveness and team engagement.

Language (see rubric appendices)



TIPS
FOR TEACHERS

The criteria in the provided rubrics can be used formatively for feedback during the process or summatively for final assessment

Rubric content: see appendices

Rubric language: see appendices

LUZ THE DARK, FIND THE LIGHT



LVL 3



1. SUBJECTS

All subjects.

2. PROJECT GOALS, LEARNING OBJECTIVES AND FINAL PROJECT

Research & understanding

- Gather information about the impact of food production and fast fashion on climate, focusing on land use, water consumption, waste, and CO² emissions.
- Investigate how art can be used as a tool to raise awareness and influence public perception.
- Conduct additional research on the social impact (e.g., labour conditions, ethical concerns) and the impact on biodiversity (e.g., habitat loss, pollution)

Systems thinking & analysis

- Analyse the fashion and food industries as complex systems, identifying key components and their interactions.
- Explore cause-and-effect relationships between industrial practices and environmental/social consequences.
- Recognize patterns in data related to climate impact and consumer behaviour.
- Campaign planning & design
- Develop a strategic plan for an awareness campaign targeting a local community, ensuring alignment with key messages and sustainability principles.
- Use artistic methods to enhance engagement and communication.
- Create campaign materials that effectively convey the researched issues.

Implementation & action

- Organize and execute the awareness campaign, applying communication and presentation skills to engage the target audience.
- Monitor the impact of the campaign through community interaction and feedback.

Evaluation & reflection

- Assess the effectiveness of the campaign, analysing what worked well and what could be improved.
- Reflect on the learning process, connecting insights from different disciplines and evaluating personal growth in critical thinking, creativity, and collaboration.

3. SDGs

This unit is related to the following SGs:



4. CROSS-CUTTING CONCEPTS

Systems and system models

Students analyse the fashion and food industries as complex systems, examining how different components (such as land use, water consumption, waste production, and CO² emissions) interact. They also explore the impact of these industries on biodiversity and social structures, seeing how changes in one part of the system can affect the whole.

Cause and effect

Students investigate how specific choices within the fashion and food industries lead to environmental and social consequences. For example, they examine how intensive agriculture contributes to deforestation and biodiversity loss, or how fast fashion increases water pollution. They also analyse how awareness campaigns can influence consumer behaviour and policy changes

Structure and function

Students explore how different artistic methods can be used to effectively communicate their message and engage the community. They experiment with how the form of their campaign influences its impact and reception.

Stability and change

Students explore the balance between economic growth and environmental sustainability. They analyse how current industrial practices destabilize ecosystems and social structures, and they evaluate potential changes that could create a more sustainable balance. They also assess how art and activism can contribute to long-term changes in societal awareness and behaviour.

Energy and matter

Students study the movement of energy and materials through the carbon cycle and water cycle, particularly in relation to food production and textile manufacturing. They explore how resources are extracted, processed, consumed, and discarded, identifying inefficiencies and opportunities for circular economy practices.

Patterns

Students analyse data on waste production, CO² emissions, and resource consumption in the fashion and food industries. They look for trends and recurring patterns to understand systemic issues and identify leverage points for change.

5. SKILLS

5.1 STEAM SKILLS

All of the STE(A)M-skills are involved in this project.

5.2 DIGITAL SKILLS

- Information and data literacy
 - Browsing, searching and filtering data, information and digital content
 - Evaluating data, information and digital content
 - Managing data, information and digital content
- Digital content creation
 - Integrating and re-elaborating digital content
 - Developing digital content
- Safety
- Problem solving
- Communication and collaboration
 - Interacting through digital technologies
 - Sharing information and content through digital technologies

6. CLIL FRAMEWORK

In this project **Awareness-raising campaign**, the 4 C's are introduced this way:

- **Content:** Develops knowledge in environmental science, social issues, and artistic activism.
- **Communication:** Strengthens academic & persuasive language through discussions, campaign materials, and presentations.
- **Cognition:** Promotes critical thinking, problem-solving, and interdisciplinary connections.
- **Culture:** Engages students in real-world sustainability challenges and ethical decision-making.

Below is STEAM-based CLIL lesson plans structured using the 4C's framework for the **Awareness-Raising Campaign Project**. This project focuses on the fashion and food industries, exploring sustainability issues and the role of art and activism in raising awareness.

6.1. THE 4 C'S

4C	DESCRIPTION
CONTENT (Subject knowledge & skills)	• Investigating the environmental and social impact of the fashion and food industries; • Analysing issues such as CO₂ emissions, land & water use, fast fashion waste, and ethical production; • Exploring how art and activism can raise awareness about sustainability; • Developing & implementing an awareness campaign using visual storytelling and strategic messaging; • Evaluating the effectiveness of communication strategies in public engagement.
COGNITION (Thinking processes, problem-solving, higher-order skills)	• Analysing how the fashion and food industries function as complex systems; • Exploring cause-and-effect relationships (e.g., "How does fast fashion contribute to water pollution?"); • Synthesizing research to design a campaign with a strong persuasive message; • Applying artistic and digital tools to create effective awareness materials; • Evaluating the impact of the campaign using community feedback & data analysis.

COMMUNICATION (Language for learning, subject-specific vocabulary, discourse functions)	• Vocabulary development: <i>sustainability, fair trade, supply chain, microplastics, circular economy, consumer behaviour, waste management</i>; • Speaking & discussion: debating ethical consumerism, explaining environmental impact, comparing fast fashion vs. sustainable fashion; • Writing & presentation: creating campaign materials (posters, social media posts, speeches), summarizing research findings; • Functional language for teamwork: assigning tasks ("You will research the environmental impact, and I will focus on ethical concerns."), planning ("The best way to reach our audience is..."), evaluating impact ("Based on our survey, people are now more aware of...").
CULTURE (Intercultural awareness, real-world application, global challenges)	• Linking to SDGs: Connecting the project to Sustainable Development Goals (SDG 12: Responsible Consumption, SDG 13: Climate Action, SDG 8: Decent Work and Economic Growth); • Exploring global and local impacts: Understanding how fashion and food choices affect the planet and different communities; • Encouraging activism & responsible citizenship: Using art and communication to influence public perception and behaviour; • Real-World Application: Creating a campaign that could be implemented in schools, communities, or online platforms.

6.2 THE LANGUAGE TRIPTYCH

L2 goals

These language goals align with the lesson objectives and ensure that students develop both content knowledge and language skills throughout the Awareness-Raising Campaign project.

Language of learning

Goal

Students will acquire and correctly use key vocabulary and grammatical structures related to environmental impact, the fashion and food industries, systems thinking, and activism through art.

Objectives

- Identify and use **subject-specific vocabulary** related to sustainability, consumerism, and activism.

- Understand and apply **comparatives and superlatives** to analyze the impact of industries (e.g., *Fast fashion is more polluting than local production*).
- For advanced learners: use **passive voice** to describe industrial processes and consequences (e.g., *Water is consumed in large amounts in textile production*).
- Construct **cause-and-effect** sentences using conditionals to explain relationships between industry practices and environmental impact (e.g., *If we reduce waste, we will decrease pollution*).

Key vocabulary and concepts

- Environmental impact: carbon footprint, CO₂ emissions, sustainability, waste management, pollution, biodiversity
- Fashion industry: fast fashion, textile production, microplastics, ethical fashion, supply chain, fair trade, upcycling
- Food industry: industrial farming, organic produce, deforestation, water consumption, food waste, circular economy
- Art & activism: visual storytelling, protest art, awareness campaigns, audience engagement, design principles
- Systems thinking: cause and effect, interconnections, subsystems, feedback loops, patterns

Vocabulary list

This vocabulary can support the students throughout the project. There is a vocabulary list (with translations) available.



VOCABULARY
LIST

Environmental & Social Issues (Fashion & Food Industry)

- **Sustainability** – Meeting present needs without harming future generations.
- **Carbon Footprint** – The total CO₂ emissions caused by an individual, organization, or industry.
- **Fast Fashion** – The mass production of cheap clothing, leading to waste and pollution.
- **Textile Waste** – Discarded clothing and fabric scraps, often ending up in landfills.
- **Microplastics** – Tiny plastic particles that pollute water, released from synthetic fabrics.
- **Deforestation** – The clearing of forests, often for agriculture, causing biodiversity loss.
- **Food Waste** – Edible food that is thrown away, contributing to environmental and economic issues.
- **Water Consumption** – The amount of water used in food and fashion production.
- **Greenwashing** – When companies falsely claim to be environmentally friendly to attract customers.
- **Biodiversity Loss** – The decline in plant and animal species due to human activities.
- **Circular Economy** – A system where products are reused, recycled, or repurposed to minimize waste.
- **Ethical Production** – Manufacturing goods in a way that respects workers' rights and minimizes environmental harm.
- **Fair Trade** – A system ensuring better wages and working conditions for farmers and workers.
- **Overproduction** – The excessive manufacturing of goods, leading to waste and unsustainable consumption.

Data Interpretation & Campaign Evaluation

- **Survey** – A method of collecting data from people to measure awareness or opinions.
- **Target Audience** – The group of people a campaign is aimed at.
- **Impact Measurement** – Assessing how effective a campaign is.
- **Consumer Behaviour** – The habits and preferences of buyers in relation to sustainability.
- **Trends** – Patterns in consumer habits, such as the growing popularity of sustainable fashion.
- **Statistics** – Numerical data used to support arguments (e.g., "90% of textile waste could be recycled.").
- **Demographics** – Characteristics of a population, such as age and interests, used for targeting campaigns.
- **Survey Response Rate** – The percentage of people who completed a survey.

Creative & Persuasive Communication (Campaign Design & Marketing)

- **Visual Storytelling** – Using images, graphics, and videos to convey a message.
- **Call to Action** – A phrase encouraging people to take action (e.g., “Buy less, choose wisely.”).
- **Infographic** – A visual representation of data and key messages.
- **Brand Identity** – The visual and messaging elements that define a campaign.
- **Typography** – The style of text used in campaign materials.
- **Colour Psychology** – The use of colours to evoke emotions and influence behaviour.
- **Slogan** – A short, catchy phrase used in campaigns (e.g., “Wear the change.”).
- **Poster Design** – The layout, colours, and images used to create an effective campaign poster.
- **Social Media Engagement** – Strategies for spreading awareness through platforms like Instagram or TikTok.
- **Persuasive Language** – Writing and speaking techniques used to convince people to change their behaviour.

Useful grammar structures

- Comparatives & superlatives (e.g., “Fast fashion is more polluting than slow fashion.”)
- Passive voice (e.g., “CO₂ emissions are reduced through sustainable farming practices.”)
- Conditionals (e.g., “If consumers demand ethical fashion, companies will change their policies.”)
- Cause and effect clauses (e.g., “Because of overproduction, textile waste has increased.”)
- Reported speech (e.g., “Stella McCartney argues that fashion should be both stylish and sustainable.”)

Language for learning

Goal

Students will use functional language to collaborate, discuss, and present their findings and campaign ideas effectively.

Objectives

- Use **clarifying and questioning strategies** to engage in discussions and refine research

(e.g., *Could you explain that in another way?*).

- Express opinions and justify arguments in **group discussions** (e.g., *“I believe that sustainable fashion is essential because...”*).
- Use **formal and persuasive language** to present research findings and campaign ideas clearly (e.g., *“Our campaign aims to raise awareness about...”*).
- Apply **planning and negotiation language** to organize and execute their awareness campaign (e.g., *“We should target..., The best way to reach our audience is...”*).

Functional phrases for research and discussion

- Asking for clarification: *“Could you explain what you mean by...?”*
- Expressing opinions: *“In my opinion, fast fashion is a major issue because...”*
- Agreeing/disagreeing: *“I see your point, but I think...”*
- Summarizing research: *“Our findings show that...”*

Functional phrases for campaign planning and presentation

- Defining objectives: *“Our campaign aims to raise awareness about...”*
- Assigning tasks: *“You will research the environmental impact, and I will focus on ethical concerns.”*
- Designing visuals: *“We should use bold colours to attract attention.”*
- Evaluating impact: *“Based on our survey, people are now more aware of...”*

Language through learning

Goal

Students will develop their language skills dynamically as they engage with new content, refine their arguments, and reflect on their learning.

Objectives

- Record and reflect on **new vocabulary and expressions** encountered throughout the project.
- Summarize research findings using **reported speech** (e.g., *“Our research showed that fast fashion contributes to...”*).

- Evaluate and articulate the impact of their campaign using **data analysis language** (e.g., “50% of participants reported that they learned something new”).
- Engage in **reflective writing** to describe personal growth and learning outcomes (e.g., “One thing I learned from this project is...”).

Strategies to encourage new language development

- Reflective writing prompts:
 - “What did you learn about the role of art in activism?”
 - “How has this project changed your perspective on fast fashion?”
- Student-led discussions: encourage students to lead discussions, introducing new terminology.
- Vocabulary log: students note new words and use them in context.
- Peer feedback: encourage students to correct and refine each other’s language use.

7. UDL

This unit makes extensive use of Universal Design for Learning (UDL) principles:

- **Multiple means of representation:** Content is presented through interactive games, visual storytelling, vocabulary scaffolding, SDG activities, artistic methods, and digital resources. Students access information about sustainability, fast fashion, and the food industry via texts, visuals, discussions, and multimedia, ensuring accessibility for diverse learning preferences.
- **Multiple means of action and expression:** Students collaborate in group roles (researcher, scribe, presenter), share findings orally and in writing, design campaign materials (posters, infographics, social media posts), and reflect through surveys and data analysis. They express understanding through both scientific reasoning and creative/artistic activism.
- **Multiple means of engagement:** The unit includes collaborative projects, real-world

awareness campaigns, links to Sustainable Development Goals (SDGs), debates, and reflection activities. Students are motivated by authentic tasks (campaign planning, community engagement) and by connecting personal choices (food, clothing) to global sustainability challenges.

8. MAIN TEACHING METHODOLOGIES

This unit centres on active, integrated STEAM teaching strategies mainly using Inquiry-Based Learning.

9. ASSESSMENT

Assessment in this unit is carried out continuously and flexibly, adapting to the needs and characteristics of each group. It focuses on both the learning process and the final outcomes, evaluating content mastery, use of the target language, and the development of transversal skills. The following strategies are proposed as general recommendations and can be adapted to suit the specific context of each classroom:

- **Systematic observation:** Teachers observe student performance throughout the unit, paying attention to task completion, organisation of work, participation in group activities, and the use of English in context. Observation also covers how students engage in vocabulary scaffolding, SDG-related tasks, and collaborative campaign planning.
- **Rubric-based evaluation of final products:** Rubrics are used to assess campaign outputs (e.g., posters, infographics, social media posts, presentations), focusing on accuracy of content, clarity of communication, creativity, feasibility of solutions, and effective use of L2 (including language accuracy, task-appropriate structures, and subject-specific vocabulary). Rubrics should be shared with students in advance (see Appendix C).

- **Self-assessment:** Students reflect on their own learning, identifying strengths and areas for improvement in collaboration, language use, and task completion. Reflection sheets or digital prompts may support this process (see Appendix D).
- **Peer assessment:** Students evaluate their own participation and that of their teammates using a shared rubric focused on collaboration, commitment, and accountability. This promotes responsibility, empathy, and critical thinking, while ensuring a fair distribution of tasks (see Appendix E).
- **Feedback from target audience:** As part of the awareness campaign, students collect feedback from peers or the local community (e.g., through short surveys or informal interviews). This provides authentic data to evaluate the effectiveness of the campaign and connects assessment to real-world impact.





7. IMPLEMENTATION IN THE CLASSROOM (DESCRIPTION OF THE SEQUENCE OF ACTIVITIES)

This final project is the corollary of previous units developed using the book *Luz sees the light*, in which students are presented with activities to acquire several skills, including those related to L2. If you decide not to implement the other units, it would be helpful that in the L2 class, students do some of the activities related to the book proposed in those units and/or the pre-teaching activity related to the book as presented in the pre-project activities-



Language support for the students: Let the students work with this language tool to get language support during the STEAM lessons.

Each of the following activities is introduced by a few suggestions for the L2 teacher. Based on the specific characteristics of the class, the teacher may decide whether or not to use certain resources.

Where this project involves previously acquired knowledge, suggestions are provided for additional activities to introduce this knowledge and skills.

Students will create an awareness campaign for their peers or the local community. We will focus on fast fashion and the food industry and use art as a way to highlight social topics.

8.1 PRE-PROJECT ACTIVITIES

Suggestion for L2 teachers:

- **Introduce the book “Luz Sees the Light”.** Use the activities provided in this document to work on the story and vocabulary before starting the science tasks based on the comic narrative, in order to establish the context of the unit. When the book has been read in advance in the language class with the planned activities, a great deal of pre-teaching has already taken place in relation to vocabulary.
- *Pre-teaching vocabulary scaffolding activity:* word sort (see next)



ACTIVITY 1

PRE-TEACHING VOCABULARY SCAFFOLDING ACTIVITY

20-35'

Activity overview

In this activity, students will work collaboratively to sort vocabulary words into different categories related to the food and fashion industries and their environmental impact. Through peer discussion, students will refine their understanding of key terms and make connections between sustainability, industry practices, and climate change.

Step 1: Introduction to the Activity

5'

a. **Set the context** by asking students:

- *“Before we start our research, let’s think about some key words related to the fashion and food industries and their impact on the environment.”*
- *“Which words do you already know? Can you think of any terms related to sustainability?”*
- Write student responses on the board as a brainstorming activity.

b. Explain the **goal** of the activity:

- *“We will work in teams to categorize key terms and explain how they relate to our topic. Some words may fit into more than one category – your job is to justify your choices!”*

Step 2: Group vocabulary sorting

10-15'

- Organize students into small groups (3-4 per group).
- Distribute vocabulary cards randomly among students.
- Give each group a set of category labels (Fashion Industry, Food Industry, Environmental Impact, Could Belong to Multiple Categories).



WORD SORT
ACTIVITY

- d. Students take turns picking a word, discussing, and placing it in a category. Encourage them to:
 - Define the word (if they know it).
 - Discuss where it fits best and justify their reasoning using sentence frames:
 - *"We think __ belongs in __ because..."*
 - *"This term fits under __ since it relates to..."*
 - *"We weren't sure if __ should go under __ or __ because..."*
- e. Groups finalize their word placements and prepare to share their decisions with the class.

Step 3: Whole-class discussion

5-10'

- a. One person from each group presents their word placements and explains their reasoning.
- b. Encourage debate and discussion:
 - Ask the class: "Does everyone agree? Why or why not?"
 - Allow students to challenge or move words if they have a strong argument.
- c. Clarify any misunderstandings by providing brief explanations and examples.

If SDGs have not yet been addressed, the activity (or alternative activity) from pages 49 and 50.



ACTIVITY 2

25'

Introduction to Luz and the book

- Show the book cover and ask:
 - What do you think this book will cover?
 - What does the title tell us about Luz?
- Give a quick summary: *"Luz is a curious girl who worries about the way we use energy. She discovers that her choices – like what she eats and wears – have a big impact on the environment. How could that be?"*

Reflect on your own choices

- Ask the class:
 - What did you eat today and where does that food come from?
 - What are you wearing today? Do you know how and where it is made?

Sorting challenge – sustainable or not?

- Divide the class into small groups and give them pictures of different foods and items of clothing.
- Have them sort into the categories "Sustainable" and "Less Sustainable" (based on energy consumption, transport, production, etc.).
- Q: How would Luz view these choices?

Reflection and prediction

- a. Have each group explain their choices and briefly discuss the hidden impact of food and clothing production.
- b. Q: What do you think Luz will find out in the book?

TIPS FOR
TEACHERS



YOUTUBE AUDIO
VERSION OF THE BOOK

Relationship between 'food industry' and the book:

- "Starting at the End"
 - Luz learns how local and organic food is better for the environment.
 - Luz explores urban gardening and tries to convince her community to be more mindful about food (e.g., setting up neighbourhood gardens)

Relationship between 'fast fashion' and the book:

- "Change is in the Air"
 - Luz and her friends brainstorm ways to be more eco-friendly, which includes reducing waste and reusing materials.

Have students write down their ideas briefly or share them in pairs.



8.2 PROJECT ACTIVITIES

80-110'

ACTIVITY 1

EXPLORING AND
GATHERING INFORMATION

Suggestion for L2 teachers:

What? Support students in discussing sustainability issues, analysing information critically, and linking to STEAM subsystems and crosscutting concepts.

Why? This develops learners' ability to express opinions, compare perspectives, and use academic language when making connections between science, technology, society, and the environment.

How?

- Revise key terms from the vocabulary list (e.g., supply chain, consumption, pollution, system).
- Use speaking cards to support group discussions and to structure the final debate.
- Assign role cards (e.g., the scribe records key arguments...)
- Refer to the Language Support Database for expressing opinion ("In my opinion...", "I agree/disagree because...") and linking ideas ("This connects to...", "On the other hand...").
- Encourage phrases like:
 - "Fast fashion impacts the environment because..."
 - "Compared to the food industry, this subsystem..."
 - "A crosscutting concept here is..."



VOCABULARY
LIST



SPEAKING
CARDS



ROLE
CARDS



LANGUAGE
SUPPORT
DATABASE

TIPS
FOR TEACHERS

The provided games can be replaced by texts, images, videos...

1.1 Food Game

30-40'

In groups, students explore food industry and fast fashion by investigating data on:

- **Food industry**
 - Land use
 - Water use
 - CO² emissions
 - Waste
- **Fast fashion**
 - Water use
 - Greenhouse gasses
 - Microplastics
 - Waste



FOOD GAME



FASHION GAME

Activity overview

Divide your class in two teams: **team Food and team Fast Fashion**. Have part of the class work on food industry and part of the class around fast fashion.

How to use the games and get most out of them?

While going through the food game and the fast fashion game, the students make notes and make sure they have a list of **food facts** and **fast fashion facts**. Encourage them to have as many as possible.

1.2 Fashion Game

20-30'

Afterwards, pair students up in teams of 2: someone who did the food game, someone who did the fast fashion game. (20 – 30 min) First, they explain their findings to each other: they share the facts they discovered throughout the game.

Together, they should formulate an answer to the following questions (have them consult additional sources if necessary) related to the crosscutting concepts:

- **Systems and System Models**
 - How do land use, water use, waste, and CO₂ emissions affect each other in the fashion and food industries?
 - What might happen to the whole system if one part (for example, waste management) changes?
- **Energy and Matter**
 - Where in the production process of clothes/food is the biggest loss of energy or materials, and how could this be improved?
- **Stability and Change**
 - How can changing certain industrial practices help balance economic growth with a healthy environment?
- **Patterns**
 - What similar patterns do you see in the food industry and clothing industry in relation to CO₂ emissions or waste generation? What do these patterns tell us about environmental impacts?

1.3 The conclusions are shared with the whole class 20-25'

Teacher monitors that within this classroom discussion the following issues are definitely covered:

- the questions above
- the different cycles involved in the food industry and fast fashion
- the **subsystems** in both subjects

Subsystems

*Crosscutting concept: System and system models

In both fast fashion and the food industry, we can look at different parts of the system. These parts are the same for both topics:

- a. Raw materials and resources
 - Fast fashion: Cotton, polyester, wool, leather, dyes, petroleum, dye-producing plants...
 - Food: Crops (wheat, rice, vegetables), livestock (cows, chickens, fish), water sources (irrigation, drinking water), farmland...
- b. Factories and processing units
 - Fast fashion: Textile factories, dyeing facilities, sewing workshops, printing units...
 - Food: Mills (grinding wheat), breweries (fermentation), packaging plants, food processing factories...
- c. Transport and logistics infrastructure
 - Fast fashion: Trucks, cargo ships, warehouses, distribution centres...
 - Food: Refrigerated trucks, cargo ships, food storage facilities, supermarkets...
- d. Retail and consumer goods
 - Fast fashion: Clothing stores, online shops, shopping malls...
 - Food: Supermarkets, restaurants, local markets, household kitchens...

1.4 Linking to SDGs (repeat or introduce)

10-15'

Ask students what SDGs are because they are going to have to use this further in the project.

A short repetition or introduction will suffice here.

"The Sustainable Development Goals (SDGs) are 17 goals created by the United Nations to make the world a better place by 2030. These goals focus on problems like poverty, pollution, climate change, and fair working conditions. In this project, we will look at how fast fashion and the food industry affect some of these goals."

Discover the SDGs:



TIPS
FOR TEACHERS

SDGs repeat or introduce

If SDGs have not yet been addressed, a specific activity can be provided for this (pre-project activity).

If the students have already come into contact with SDGs, a short repetition will suffice here.

ACTIVITY 2

THE POWER OF ART

45-60'

The focus in this group activity is on discovering the ability of art to raise awareness.

Suggestion for L2 teachers:

What? Support students in researching information and discussing the role of art as a tool for awareness or social change.

Why? This allows learners to practice collaborative language while searching, analysing, and evaluating information in English.

How?

- Use speaking cards for group work and reflection when analysing art examples.
- Assign role cards to ensure equitable contributions during research and discussion.
- Refer to the Language Support Database for language of interpretation ("This artwork represents...", "The message could be...") and comparisons.
- Encourage phrases like:
 - "This artwork shows the power of..."
 - "We found that art influences people by..."
 - "How can we connect this to our project theme?"



SPEAKING
CARDS



ROLE
CARDS



LANGUAGE
SUPPORT
DATABASE

Art and awareness

Students are given a dossier containing information about different artists such as Banksy (graffiti artist), Stella McCartney (fashion designer), Chris Jordan (photographer) and for each artist they have to answer the question (in the group discussion) about how these artists try to make us aware of certain issues related to climate change.

25-35'

Then they themselves, (in their group) will look for an example from the music. They gather some information and mention how these artist(s) are also trying to make people aware of certain challenges.

15-25'



EXAMPLE
DOSIER: ART

Students can create a digital file per team and thus collaborate digitally on a single document.

Differentiation: for more advanced groups, freedom can be given to choose an artist and/or art form.

TIPS FOR
TEACHERS

Suggestion for L2 teachers:

What? Guide students in formulating research questions, gathering data, and linking their findings to the Sustainable Development Goals.

Why? This helps learners practice academic skills such as questioning, synthesizing, presenting, and engaging in class-wide discussions in the target language.

How?

- Introduce or revise key terms e.g., sustainability, innovation, equality, impact.
- Use this interactive presentation to review the different SDGs.
- Procedure on how you can use this in class:
 - Students will briefly explore and understand a specific Sustainable Development Goal (SDG) relevant to the current assignment and share their findings with their peers.
 - Students are each assigned or choose one specific SDG (Sustainable Development Goal) from an interactive image (like the one provided) that is relevant to the current project or assignment.
 - They use the interactive elements (e.g., clicking on the goal to access a brief summary, key targets, or related information) to quickly explore and familiarize themselves with their assigned SDG. They should focus on its core meaning and how it relates to the current task.
 - After a short exploration period (e.g., 5-10 minutes), students participate in a brief knowledge exchange. They form small groups (e.g., 3-5 people, each with a different SDG) and take turns briefly explaining their assigned goal and its connection to the task.
 - All students gain a rapid overview of the relevant SDGs and how they connect to the project, fostering a shared understanding before continuing the main work.
- Use speaking cards to structure group reflection and to prepare the presentation.
- Assign role cards so each group member has a clear responsibility (e.g., the chief coordinates research, the scribe summarizes findings).
- Use the Language Support Database for forming research questions ("How does... affect...?") and reporting ("The results show that...").
 - *Encourage phrases like:*
 - *"Our research question is..."*
 - *"The connection to SDG number X is..."*
 - *"One conclusion we can draw is..."*



INTERACTIVE
PRESENTATION



SPEAKING
CARDS



ROLE
CARDS



LANGUAGE
SUPPORT
DATABASE

3.1 Making the requirements explicit

10'

The pupils challenge consists of

- Setting up an awareness campaign
- For the local community (or subset)
- E.g. peers, students own school, neighbourhood
- Art should be a component of the campaign
- In addition to the previous information, additional research should be done on one of the following aspects: (1) Impact on biodiversity or (2) social impact. (see activity 3)

3.2 Research activity

60-90'

In groups, students will conduct an investigation around either food industry or fast fashion, delving deeper into either biodiversity* or social impact* (Crosscutting concept: Cause and effect). There is an explicit focus on the relevant SDGs in this investigation.

The end product is an artefact that can be used in the campaign to set up.

Roadmap for the students :

- Choose your research topic & focus area
- Formulate your research question
- Collect information
- Link your research to a SDG
- Make a presentation for your research results
- Present and discuss



ROADMAP FOR THE STUDENTS

It can be motivating for the students if you let the students choose between food/fashion themselves and then discuss within their group whether to investigate biodiversity or social impact further).

Depending on the experience of the group, students may or may not choose to use



CRITERIA FOR GOOD RESEARCH QUESTION

the guidelines for a good research question.



Suggestion for L2 teachers:

What? Support students in using project management and persuasive language while planning, designing, and realizing a campaign for a specific audience.

Why? This strengthens learners' ability to collaborate, negotiate tasks, and communicate impactful messages in English.

How?

- Introduce or revise key terms e.g., target audience, message, strategy, impact.
- Use speaking cards for group work (decision-making, reflecting, presenting ideas).
- Assign role cards to divide campaign tasks (e.g., the chief organizes planning, the helper prepares visuals).
- Refer to the Language Support Database for persuasive language ("We should...", "Our campaign will...", "This message is effective because...").
- Encourage phrases like:
 - "Our main target group is..."
 - "The most effective way to reach them is by..."
 - "Let's plan the steps and divide the tasks."

SPEAKING
CARDSROLE
CARDSLANGUAGE
SUPPORT
DATABASETIPS
FOR TEACHERS

Limit the size of the groups to 4 students so that everyone is actively involved.

Role cards and speaking cards can also be used in the groups.

Some of the questions can be answered by the students themselves or (within the framework of context, time, resources, group...) determined by the teacher or in consultation.

Tip: When guiding the groups, ask explicitly about the connection between how they shape things (communication, use of art...) and their target audience/purpose. (Cross-cutting concept: structure and function).

4.1 Design Questions

Each group formulates an answer to the following questions regarding the campaign to be set up.

Questions:

- What information do we still need to organise our campaign?
- Who is our target audience?
 - Can be left open and pupils decide for themselves
 - Can be determined by teacher e.g. peers
- How can we best address them?
 - What additional information do we need concerning the target group?
 - How are we going to collect it?
 - Possibly interview some stakeholders, look it up, online survey...
 - How are we going to process them?
- What artistic element(s) can we use in your campaign to make the message clear and memorable?
 - Only work with recycled materials...

- Best to leave open so students can decide for themselves. E.g. making new garment from reclaimed material, artwork with recycling material, photos....
- How much time do we have to prepare this?
- How much time is there to carry this out?
- How will we check if our campaign has had results? When is our campaign a success?

Once the group has an answer to the previous questions, they can start formulating and evaluating their ideas in concrete terms.

- Formulating concrete ideas
- Evaluate quantity of ideas

After students have formulated a quantity of possible actions via mind mapping, it is time to evaluate them.

Through the NAF system, the ideas are evaluated using

- Novelty: how innovative is our idea?
- Attractiveness: how attractive is this to the target group?
- Feasibility: degree to which it is feasible according to time and resources

Brief preparation to pitch the group's ideas to the full class group using the NAF- template.



NAF TEMPLATE

4.2 Presentation of the ideas and selection of activities

After the pitch of the different groups, all students will receive 3 sticky dots in different colours. One colour for first choice (3 points), one colour for second choice (2 points) and one colour for third choice (1 point).

They are given 2 minutes to stick their sticky dots on their chosen activities.

The activities with the highest ranking are eligible to be worked on.

Classroom adjustments are then agreed upon, if necessary.

4.3 Planning

Guiding questions

- Additional research needed before starting (e.g. on target group)?
 - Divide tasks
 - Planning for the research
- Making artefacts
 - Artwork(s)

Formulating concrete ideas

Suggestion: Mind Mapping (Concept mapping)

- Goal: To visually organize ideas and identify connections within the system.
- How it works: Start with a central theme. Students can write down related ideas around the theme, such as energy sources, eco-friendly materials, user convenience, and infrastructure. They can then draw lines to show connections between ideas.
- Benefit: Mind mapping helps students **think in systems** by **making connections** between different elements visible.

Evaluate quantity of ideas

Use the NAF template or



OTHER TECHNIQUES

Tip: with the different groups, monitor the feasibility in particular (depending on available time and resources), so that this score can be adjusted after the pitch, if necessary.

Artefacts: Any products that were the result of other units can also be integrated (e.g. smart greenhouse).

The project template is now filled in with some examples, which should be adapted to the decisions made at this stage



PROJECT
TEMPLATE

- Materials for campaign
 - e.g. blog for reaching out to peers, materials for exhibition... (this is where the earlier artefacts students made in the introduction can also find their place), flyers for the neighbourhood...
- Divide tasks (to groups or individual students)
- Determine milestones...

4.4 Campaign realisation

duration is very flexible

Preparation:

- Previous will be carried out
- Ensure interim evaluation/follow up and adjustment
- Result: all artefacts are ready

Implementing campaign:

Depending on what pupils/teachers have decided (together)

- Exhibition
- Online campaign
- Fashion show
- Play
- ...

4.5 Campaign evaluation

45-60'

Reflection

- What went well?
- What challenges did we face?
- What would we do differently next time?
- What impact did we create?
 - Based on the results of the previously defined method by which impact should be measured

PROJECT ASSESSMENT

20-60'

Content (see rubric appendices)

Possible evaluation methods:

- Individual reflection report:
 - Students write a personal report reflecting on their learning process and campaign impact.
- Peer Review:
 - Students assess each other's work using a simplified version of the rubric.
- Presentation with Q&A:
 - Students present their campaign and justify their choices before a jury (e.g., teachers, external experts, classmates).
- Portfolio Assessment :
 - A collection of their research, analyses, campaign plans, and reflections is evaluated.
- Teacher Observation & Assessment:
 - During campaign execution, the teacher evaluates message effectiveness and team engagement.

TIPS FOR
TEACHERS

The criteria in the provided rubrics can be used formatively for feedback during the process or summatively for final assessment.

Rubrics:

- Content evaluation Level 3 (Appendices)
- L2 (Appendices)

Language (rubric appendices)



APPENDICES





APPENDIX A SUGGESTED READING MATERIALS BY CEFR LEVEL

To support the development of each student and adapt reading materials to different language proficiency levels, the following list of recommended books is organised according to the CEFR scale:

- **A2 level:** *A Planet Full of Plastic* by Layton, N. (2019). Wren & Rook. A visually engaging book that introduces the topic of plastic pollution in simple, accessible language, ideal for early secondary learners.
- **B1 level:** *Plasticus Maritimus: An Invasive Species* by Pego, A., Carvalho, B. P., & Minhós Martins, I. (2020). Greystone Kids. A semi-narrative, informative text that raises awareness and encourages personal reflection through clear language and real-life connections.
- **B2 level:** *What a Waste: Trash, Recycling, and Protecting Our Planet* by French, J. (2019). DK Children. A comprehensive resource that explores environmental challenges with rich vocabulary, infographics, and explanatory content suitable for upper-intermediate learners.
- **C1 level:** *Plastic Soup: An Atlas of Ocean Pollution* by Roscam Abbing, M. (2018). Island Press. An advanced text combining scientific data, global case studies, and persuasive arguments, ideal for learners developing academic reading and critical analysis skills.

APPENDIX B RELATION WITH OTHER SUBJECTS

Throughout the different levels of the project, various subject areas have already been explicitly addressed. The following list outlines additional possible connections with other curricular subjects that may be relevant to this unit. These are not proposed activities, but rather suggestions intended to inspire further interdisciplinary integration where appropriate. Teachers are free to adapt or incorporate these ideas according to their context and objectives. Their inclusion is entirely optional and meant to support flexible implementation of the project.

1. Visual arts/media

Possible connections:

- Graphic novel remix (different style: collage, lino, painting).
- Mixed-media poster (photo + comic captions).
- Stop-motion animation.
- Digital art: futuristic sustainable city.
- Photovoice project with captions.

2. Music

Possible connections:

- Create soundtracks for comic scenes.
- Rap / slam poetry about sustainability.
- Soundscapes representing fast fashion / fast food.

3. Drama/theater

Possible connections:

- Act out comic scenes with exaggerated gestures.
- Forum theatre: students change outcomes (e.g., sustainable choices).
- Improv: invent new eco-heroes as characters.

4. Dance/Movement

Possible connections:

- "Energy in motion" dance improvisation (movement linked to energy types)
- Choreography contrasting fast vs. slow fashion.

5. Cross-over (Art and Technology)

Possible connections:

- Augmented reality poster (strip characters “come alive”): containing QR codes or AR markers that link to student-made videos, audio messages, or comic animations. Example: scan Luz’s poster and see her talk about sustainable energy.
- Interactive comic installation (lights/sounds with circuits).

6. Technology and digitalisation

Design and engineering

- Students design car parts, greenhouse models, or everyday sustainable tools in software such as Tinkercad. Designs can be printed and tested.
- Learners create a virtual 3D greenhouse or city model (SketchUp, CoSpaces, MinecraftEdu) and simulate “what if” scenarios (e.g., more/less sunlight, energy sources). Supports systems thinking and visualizing sustainability.

Coding and simulation

- Students code a short animation (e.g., Luz explaining energy transformation, photosynthesis process). Supports narrative storytelling with coding logic.
- With MIT App Inventor or Python, students build a sustainability quiz app (e.g., “Fast fashion: true or false?”). Useful for peer teaching in English.
- Learners collect real greenhouse data (temperature, growth, light) and visualize it with Excel, Python, or Google Sheets. Links scientific measurement with digital literacy.

Interactive media

- Using Pixton, Canva, or StoryboardThat, students create their own “**Luz spin-off stories**” (e.g., Luz builds a greenhouse, Luz campaigns against fast fashion).
- Students **design a mini-game** in Scratch or Roblox Studio where players “earn points” for sustainable actions (e.g., cycling vs. driving).

Communication & campaigning

- Students set up a **class blog** (WordPress/Wix) about sustainability. Sections could include Luz’s diary, sustainable lifestyle tips, and student-created comics. Language focus: persuasive writing and reporting.
- In groups, students design mock **Instagram/TikTok posts, memes, or infographics** as if Luz were an activist influencer. Focus on multimodal literacy and persuasive language.
- With Scratch, Python, or online tools, students **code a simple chatbot** that answer questions like “What is fast fashion?” or “How to save energy?” Good practice for written dialogues in English.

7. History

Possible connections:

Explore how energy use changed over time (steam → electricity → renewables). Compare traditional vs. modern farming. Study industrialisation as root of mass production, fast fashion & food industries.

8. Geography

Possible connections:

Students analyse where energy sources are located, how climate impacts crop growth, and trace the path of products (cotton, soy, meat) from production to consumer.

9. Economics/Business

Possible connections:

Calculate production costs of prototypes (e.g., rubber band car). Analyse supply and demand in greenhouse farming. Compare ethical vs. fast fashion/food economics.

10. Social Studies

Possible connections:

Students role-play as policymakers making sustainability rules, discuss consumer rights and fair labour, and evaluate local/global community effects.

APPENDIX C

ASSESSMENT RUBRIC OF FINAL PRODUCTS

The following rubric is provided as a flexible and optional tool to support the evaluation of student projects. It is designed to guide assessment through clear, observable criteria while allowing teachers to adapt it to their specific context or needs.

	CRITERIA	EXCELLENT (4)
STEM skills	1. Problem identification and model-based thinking	The product is based on a clearly formulated and relevant real-world problem or question. It includes one or more models (visual, conceptual, physical or symbolic) that effectively represent core concepts or systems and help explain the problem or solution.
	2. Reasoning, planning and structured problem-solving	The product shows a clearly structured approach to problem-solving. Reasoning is logical and well-sequenced, and the proposed solution addresses the problem effectively with justified steps, mechanisms or principles.
	3. Evidence-based argumentation and data interpretation	The product integrates specific data, factual information, or observed evidence to support decisions or claims. Interpretation is accurate and shows clear understanding of relationships, causes or consequences.
	4. Information management and scientific communication	Information is relevant, accurate and well organised. Scientific content is communicated clearly, using appropriate formats (labels, captions, diagrams, visual hierarchies, etc.) and adapted to the intended audience and goal.
	5. Creative and artistic expression	Artistic or design elements are used purposefully to enhance meaning, engagement and communication. Composition, colour, symbolism or other visual resources reflect clear creative intention and coherence.
L2	6. Accuracy and range of language	The product demonstrates consistent accuracy in grammar, spelling, punctuation and word choice. A wide range of vocabulary and structures is used appropriately to express meaning with precision and fluency.

Scan here to download the interactive rubric. You can enter scores directly into the file, and the total will be calculated automatically out of 10.



This resource is intended to simplify assessment, enhance transparency, and encourage consistency. However, its use is not mandatory: teachers are free to adjust the criteria, scoring scale, or final weighting, or to use a different tool altogether, depending on the goals of the project and the characteristics of their classroom.

GOOD (3)	SATISFACTORY (2)	NEEDS IMPROVEMENT (1)
The product presents a mostly relevant problem or question, with a model or visual representation that contributes to understanding but may lack precision or completeness.	The problem is present but is poorly defined, generic or only loosely linked to real-world issues. The model is simplistic, underdeveloped or not clearly linked to the problem.	The product lacks a defined problem or guiding question. No meaningful model is used, or the representation is disconnected, unclear or decorative only.
The product includes a mostly logical sequence, with a solution that is appropriate and functional, though not deeply justified or partially disconnected from the problem.	The reasoning or planning is partially evident, but the steps taken are disorganised, oversimplified or contain inconsistencies. The solution is incomplete or vague.	The product lacks visible reasoning or planning. The solution is missing, irrelevant or incoherent in relation to the problem.
The product includes data or information, with basic explanation or justification of its relevance. Interpretation is present but lacks depth or detail.	Limited or superficial use of evidence. Connections between information and conclusions are unclear or weakly reasoned.	No use of data or observable evidence. The product relies on opinions or assumptions without justification.
Information is generally relevant and understandable, though some ideas may lack clarity or structure. Formatting and visual organisation support the message adequately.	Content includes inaccuracies, vague phrasing or lacks coherence. The message is partly understandable, but the structure or design hinders comprehension.	The product is disorganised or contains significant errors. Scientific content is poorly presented, confusing or inappropriate for the audience.
The product includes appropriate and mostly effective artistic or creative elements. Visuals or design contribute to the message, though they may be conventional or uneven.	Some aesthetic elements are present but are poorly developed, unbalanced or lack integration with the message. Creative intent is limited.	Visual or artistic resources are absent, minimal or irrelevant. The product shows little creative effort or visual coherence.
Language is mostly accurate with only occasional minor errors that do not affect understandability and structures show some variety and are appropriate to the topic.	Frequent grammatical or lexical errors that occasionally interfere with meaning. Limited range of structures or repetitive vocabulary.	Persistent errors in grammar or vocabulary that significantly hinder comprehension. Very limited or inappropriate use of English.

	7. Clarity and coherence of message	The message is logically organised and easy to follow. Ideas are clearly connected through effective transitions and the overall structure supports comprehension.
	8. Adequacy to format and audience	The language used is fully appropriate to the type of product (e.g., comic, campaign, report, script) and adapted to its intended audience in tone, register and purpose.
	9. Oral and/or written fluency	Written texts are fluent and natural-sounding, with good rhythm and readability. Oral performance (if present) is confident, intelligible and expressive, with accurate pronunciation and appropriate intonation.
Digital Skills	10. Purposeful use of digital tools	Digital tools are used appropriately and effectively to enhance the creation, organisation and/or communication of the product. Tool selection shows autonomy, accuracy and relevance to the task.
	11. Quality of the digital product	The product is technically well-executed: sound, image, layout, transitions and design elements (e.g., fonts, colours, spacing) are coherent, attractive and professional. No technical flaws are present.
Sustainability/ ODS	12. Understanding of the sustainability issue	The product demonstrates a deep and accurate understanding of the environmental or social issue addressed. Causes, consequences and connections to the selected SDG are clearly explained or represented.
	13. Proposed action, solution or awareness strategy	The product includes a realistic, well-argued and contextually relevant proposal to address the issue. The action or message is creative, feasible and shows strong commitment to sustainability.
Other	14. Critical thinking and transfer	The product demonstrates the ability to apply concepts, methods or content from different areas in a new or real-world context. The ideas show thoughtful reflection, analysis and clear relevance.
	15. Adequacy to product format and purpose	The product fully respects the structural, visual and communicative conventions of the chosen format (e.g., comic, campaign, presentation). It is well adapted to the intended audience and purpose.

The message is generally clear and coherent. Some minor lapses in organisation or flow, but the main ideas are still understandable.	The message is unevenly structured or contains unclear sections. Transitions may be missing or poorly used, affecting comprehension.	The message is difficult to follow due to poor organisation, unclear sentence structure or lack of I
The language fits the format and audience in general terms, though some inconsistencies in tone or formality may appear.	The use of English only partially matches the conventions of the format or the expectations of the audience. Inconsistent tone or awkward phrasing.	Language is inappropriate for the format or audience. The tone, formality or structure do not match the task.
Written or spoken English is mostly fluent and understandable. Some hesitation, mispronunciation or unnatural phrasing, but communication is not seriously affected.	Limited fluency with noticeable pauses, mispronunciations or awkward phrasing. Some sections are difficult to follow.	Lack of fluency. Written text is fragmented or confusing. Oral delivery (if applicable) is unclear, monotonous or hard to understand.
Digital tools are used adequately and contribute to the product. Tool choice is mostly appropriate, though not fully optimised or creatively exploited.	Some digital tools are used, but their integration is limited or basic. Tool selection may be partially relevant or show signs of dependency.	Little or no use of digital tools, or tools are misused or irrelevant to the product. Digital integration is weak or absent.
The product is mostly correct in technical terms, with minor flaws (e.g., layout inconsistencies, timing issues, audio clarity) that do not affect overall impact.	The product contains technical issues (e.g., resolution problems, unreadable text, disjointed visuals) that reduce quality or clarity.	The product is technically poor. Major issues in format, visuals, audio or navigation hinder comprehension or presentation.
The product shows a solid understanding of the issue. The SDG is relevant and mostly well linked, though some aspects (causes, impacts, scope) may lack development.	The issue is present but only partially understood. The SDG is included but superficially treated or loosely connected to the content.	The problem is unclear, misunderstood or missing. There is no evident link to an SDG or the reference is incorrect or irrelevant.
A proposal or awareness message is present and relevant, though general, partially developed or lacking in originality or depth.	The proposed action is vague, unrealistic or only loosely connected to the issue. Impact or feasibility is limited or unclear.	No clear proposal or message is included, or the solution is unrelated, impractical or missing entirely.
Evidence of application and reflection is present, with reasonable connections to new contexts. Critical thinking is present but not consistently deep.	Some attempt to apply prior knowledge or reflect on implications, though ideas may be generic, underdeveloped or only partially connected.	No clear evidence of transfer or critical thinking. Ideas are repeated, disconnected or lacking in relevance or depth.
The product mostly fits the chosen format and communicates its purpose clearly, with some minor deviations or inconsistencies.	The product loosely follows the format, but issues in structure, tone or design reduce its effectiveness or clarity.	The product does not respect the basic conventions of the format or fails to convey its purpose effectively. It may appear unfinished or incoherent.

DETAILED L2-ASSESSMENT RUBRIC (L2 USE AND UNDERSTANDING)

This competency-based rubric ensures a clear assessment structure where teachers can indicate the student's level in each category by marking the corresponding star rating.

LANGUAGE CRITERIA	5 STARS (EXCELLENT)	4 STARS (GOOD)
Use of subject-specific vocabulary	Demonstrates extensive use of precise and varied subject-specific vocabulary.	Uses a wide range of relevant vocabulary accurately.
Grammar and sentence structure	Uses a wide variety of grammatical structures with accuracy and control.	Uses a range of grammatical structures effectively, with minor errors.
Clarity and coherence in communication	Presents ideas in a highly structured, logical, and engaging way.	Ideas are well-organised and expressed clearly, making the message easy to understand.
Confidence and fluency in L2	Communicates effortlessly with confidence, fluency, and natural flow.	Speaks and writes fluently, showing confidence and good pace.
Engagement in discussions and teamwork using L2	Demonstrates leadership in discussions, responding naturally and using L2 confidently.	Actively contributes to discussions, using L2 effectively.

3 STARS (SATISFACTORY)	2 STARS (DEVELOPING)	1 STAR (NEEDS IMPROVEMENT)
Uses subject-specific vocabulary with occasional mistakes.	Uses some key terms but with errors or inconsistencies.	Limited use of key vocabulary; frequent inaccuracies.
Uses a mix of simple and complex structures with occasional errors.	Uses basic grammar structures with some errors affecting clarity.	Frequent grammar errors that hinder communication.
Communicates clearly but with occasional issues in structure or coherence.	Expresses ideas but with noticeable gaps in clarity and organisation.	Ideas are difficult to follow due to lack of structure and clarity.
Speaks and writes with reasonable fluency but with some hesitation.	Communicates with effort but with frequent pauses and difficulty.	Hesitates frequently, struggling to form sentences.
Engages in discussions, though with some reliance on support.	Participates with difficulty, needing prompts and support.	Rarely participates in discussions or uses L2 minimally.

DETAILED LEVEL 1 CONTENT EVALUATION

This competency-based rubric aligns with the various project activities and ensures a clear assessment structure where teachers can indicate the student's level in each category by marking the corresponding star rating.

CRITERIA	5 STARS (EXCELLENT)	4 STARS (GOOD)
Gathering and sharing information		
Facts and data	Extensive, accurate, and well-organized knowledge on lever principles, types, and real-world applications, and shared confidently in group/class.	Many relevant facts on levers are collected and explained with examples.
Prototyping design, construction and testing		
Design and planning	Highly creative, detailed design plans for two mousetrap cars, with subsystem analysis and clear group roles.	Well-structured plans for both cars with strategies and defined roles.
Construction and testing	Two prototypes built to high standard, rigorously tested, optimized, and fully documented.	Two cars constructed, systematically tested with clear data.
Data analysis and optimization	Excellent analysis of test results; strong justification for selecting one prototype and implementing effective optimizations.	Clear analysis of results with logical modifications to improve performance.
Reflection and evaluation		
Self-reflection and group evaluation	Deep, critical reflection on personal learning, lever principles, prototype choices, performance, and group collaboration.	Clear reflection with concrete insights into design, results, and teamwork.

3 STARS (SATISFACTORY)	2 STARS (DEVELOPING)	1 STAR (NEEDS IMPROVEMENT)
Basic lever facts (e.g., law of the lever) provided with some examples.	Some facts are mentioned but lacking detail or clarity.	Few or no relevant facts gathered or shared.
Basic plans for both cars with some sketches and materials noted.	Minimal planning or unclear roles.	No clear design or planning.
Cars constructed, tested with average results, basic data recorded.	Cars show limited functionality; testing incomplete.	Cars poorly constructed or missing; no testing.
Basic analysis with some improvements attempted.	Minimal analysis, vague observations, few optimizations.	No analysis or improvements made.
Basic reflection identifying some strengths and weaknesses in design and group collaboration.	Limited reflection with few insights; group work not discussed.	No reflection or evaluation of the process.

SDGs		
General	Makes a clear and insightful connection between the project outcomes (lever efficiency, optimization, collaboration) and one or more SDGs. Provides concrete examples of how the project links to sustainability.	Explains the link between the project and SDGs with some relevant examples.
Integration of crosscutting concepts		
Scale and porportion	Provides detailed explanation of how different lever classes and proportions of lever arms affect power and performance, supported by test evidence.	Explains how lever arm size or lever class influences performance with some examples.
Cause and effect	Provides thorough analysis of how design choices (lever arm length, wheel size, material) affect performance; supports with data and clear explanations.	Explains design choices and their impact on performance with relevant examples.
Structure and function	Insightfully explains how lever classes, design features, and material choices influence vehicle efficiency and movement.	Clearly explains how design and structure affect function and performance.

- **Gathering and sharing information** (Facts on energy, forms of energy; energy conversion, renewable systems...)
- **Prototype design, construction and testing** (Planning, building, testing, and optimising the prototype)
- **Reflection and evaluation** (Reflection on the design process, prototype performance, and group collaboration)
- **Integration of crosscutting concepts** (This section assesses how well student explicitly address and apply key crosscutting principles in their project, including cause and effect, structure and function, and scale and proportion).

Mentions the SDGs and gives a basic explanation of how the project relates to sustainability.	Refers to the SDGs briefly but without explanation or examples.	No connection to SDGs made.
Basic recognition that longer or shorter lever arms affect the car.	Mentions lever length but without clear reasoning.	No attention to scale or proportion.
Gives a basic explanation of how lever arm length or materials affect performance.	Mentions cause-effect vaguely, little explanation.	No cause-effect discussed.
Basic explanation of how structure influences movement.	Mentions structure or function without clear link.	No link between structure and function.

DETAILED LEVEL 2_1 CONTENT EVALUATION

This competency-based rubric aligns with the various project activities and ensures a clear assessment structure where teachers can indicate the student's level in each category by marking the corresponding star rating.

CRITERIA	5 STARS (EXCELLENT)	4 STARS (GOOD)
Gathering and sharing information		
Facts and data	Extensive, accurate, and well-organized data that is convincingly shared in class discussions.	Many relevant facts are collected and clearly communicated with supporting details.
Prototyping design, construction and testing		
Design and planning	An outstanding and creative design plan that fully meets the requirements, with detailed subsystem analysis and clear, innovative planning.	A well-structured design plan with clear strategies, detailed planning, and defined group roles.
Construction and testing	Prototype is exceptionally built, rigorously tested, and optimized; testing data is well-documented and analysed.	Prototype is well-constructed, meets design criteria, and testing is conducted systematically with clear data.
Data analysis and optimization	Comprehensive data analysis leads to insightful optimizations; improvements are well-justified and effectively implemented	Clear analysis of results with logical modifications to improve performance.
Reflection and evaluation		
Self-reflection and group evaluation	Deep, critical reflection on personal learning, lever principles, prototype choices, performance, and group collaboration.	Clear reflection with concrete insights into design choices, performance outcomes, and group dynamics.
SDGs		
SDG analysis and discussion	Delivers an in-depth analysis that insightfully connects multiple project outcomes to the SDG, using strong, concrete examples and critical commentary.	Clearly explains the assigned SDG with several specific examples from various activities (rubber band car, renewable energy systems, building efficiency).

3 STARS (SATISFACTORY)	2 STARS (DEVELOPING)	1 STAR (NEEDS IMPROVEMENT)
Basic facts on energy forms, conversion, and renewable systems are gathered and shared.	Some facts collected, but details or organization are lacking.	Few or no relevant facts gathered, unstructured.
A clear design plan is presented with basic ideas on materials, subsystems, and roles.	Basic design is proposed with minimal planning details or unclear roles.	No clear design or planning evident; requirements are not met.
Prototype is built to meet basic criteria and testing is conducted with average results.	Prototype is constructed with limited functionality; testing shows minimal effort.	Prototype is poorly constructed or not built; testing is absent or inconclusive.
Basic analysis of test data is provided and some improvements	Minimal analysis; some observations are noted but no clear optimization.	Little or no analysis of test results; no improvements are made.
Basic reflection identifying some strengths and weaknesses in design and group collaboration.	Limited reflection with few insights; group work not discussed.	No reflection or evaluation of the process.
Provides a basic explanation of the SDG with some relevant examples from project activities (e.g., linking energy conservation in the rubber band car to sustainable energy use).	Mentions the assigned SDG with little explanation and few examples.	Does not address the SDG or its relevance.

SDG creative presentation	Presentation is exceptional, highly creative, and powerfully communicates the SDG connection with excellent use of visuals, examples, and engaging methods.	Presentation is well-organized, engaging, and uses creative methods (e.g., posters, role-play) to effectively communicate the SDG connection.
SDG reflection	Presents a deep, thoughtful reflection that critically examines the SDG's importance, connects multiple project aspects to sustainable practices, and suggests future applications of the knowledge gained.	Offers clear reflection with concrete examples on how energy conservation and efficiency in the project support the SDG.
Integration of crosscutting concepts		
Energy systems & patterns	Offers a detailed, insightful explanation of the prototype's system interactions and recurring performance patterns, backed by strong examples.	Clearly explains the prototype as a system with defined subsystems and identifies patterns (e.g. consistent test results) with examples.
Cause and effect & stability and change	Delivers a thorough analysis of cause-effect relationships and discusses how small changes lead to significant performance differences, with strong examples.	Provides clear explanations of how design changes (e.g., material choices, axle alignment) affect energy conversion and performance stability.
Structure and function & energy and matter	Provides an exceptional, in-depth explanation linking design structure, function, and material properties to energy conversion, transfer, and conservation with insightful examples.	Clearly explains how design choices enhance energy conversion (e.g., from potential to kinetic) and reduce losses (e.g., friction), including relevant material properties.

- **Gathering and sharing information** (Facts on energy, forms of energy; energy conversion, renewable systems...)
- **Prototype design, construction and testing** (Planning, building, testing, and optimising the prototype)
- **Reflection and evaluation** (Reflection on the design process, prototype performance, and group collaboration)
- **SDG integration and reflection** (This section specifically assesses the concluding activity where groups connect their project outcomes (energy conservation, energy transfer, and optimization) to a specific SDG (e.g., SDG 7, SDG 12, or SDG 13), discuss the relevance using concrete project examples, and present their findings creatively).
- **Integration of crosscutting concepts** (This section assesses how well student explicitly address and apply key crosscutting principles in their energy project, including systems and system models, cause and effect, structure and function, stability and change, energy and matter, patterns, and scale and proportion).

presentation is clear with some creative elements; the SDG connection is mentioned but could be expanded	Presentation is basic and mentions the SDG but is not very engaging or clear.	Presentation is unclear, lacks creativity, and does not effectively convey the SDG connection.
Provides a basic reflection on how the project activities relate to the SDG, with limited examples.	Minimal reflection with little insight into the relevance of the SDG.	No reflection on the SDG is provided.
Provides a basic analysis of how parts (e.g. rubber band, wheels) interact and notes some patterns from test data.	Briefly mentions system components with minimal detail on recurring patterns.	Does not address systems or patterns.
Explains basic cause-effect relationships (e.g., increased rubber band tension leads to longer travel) and notes simple stability issues.	Mentions cause and effect in passing; minimal discussion of how modifications impact performance.	Does not address cause and effect relationship or changes.
Offers a basic explanation of how the structure (materials, shapes) influences energy conversion and transfer in the prototype.	Mentions design and material choices with limited connection to energy concepts.	Does not address the relationship between design features and energy processes.

DETAILED LEVEL 2_2 CONTENT EVALUATION

This competency-based rubric aligns with the various project activities and ensures a clear assessment structure where teachers can indicate the student's level in each category by marking the corresponding star rating.

CRITERIA	5 STARS (EXCELLENT)	4 STARS (GOOD)
Gathering and sharing information		
Facts and data	Extensive and accurate data collected and convincingly shared in class/with peers.	Many relevant facts collected and clearly shared with peers.
Prototyping design, construction and testing		
Design and planning	An outstanding, design plan that fully meets project requirements, with precise geometric design and innovative features for optimal plant growth.	A well-structured design plan with detailed planning, clear roles, and a thoughtful approach to environmental considerations
Construction and testing	Prototype is exceptionally built, rigorously tested, and optimized; performance data is well-documented and used to refine the design.	Prototype is well-constructed, meets design criteria, and testing is conducted systematically with clear data.
Data analysis and optimization	Comprehensive data logging, precise calculations, and insightful analysis (using graphs and ratios) drive clear conclusions and improvements.	Data logging, calculations, and graphical analysis are clearly executed, supporting design decisions.
Digital skills: programming and automation		
Sensor programming and data logging	Digital programming is exemplary; sensors function flawlessly, and data logging is automated and integrated seamlessly into the design process.	Sensors are well programmed; data logging is systematic and accurately reflects environmental conditions, aiding in design decisions.
Actuator control and automation	Actuator programming is outstanding; the digital system actively and accurately optimizes greenhouse performance in real time, demonstrating high-level competency in automation and control.	Actuator control is well executed; digital automation effectively adjusts greenhouse conditions based on sensor feedback.

3 STARS (SATISFACTORY)	2 STARS (DEVELOPING)	1 STAR (NEEDS IMPROVEMENT)
Basic facts gathered and shared with peers.	Some facts collected, but lack structure and detail.	Few or no relevant facts gathered, unstructured.
A clear design plan is presented with basic ideas on materials, subsystems, and roles.	Basic design is proposed with minimal planning details or unclear roles.	No clear design or planning evident; requirements are not met.
Prototype is built to meet basic criteria and is tested with average results.	Prototype is constructed with limited functionality; testing shows minimal effort.	Prototype is poorly constructed or not built; testing is absent or inconclusive.
Data is recorded and basic calculations (percentages, ratios, area/volume) are performed; analysis is satisfactory.	Some data is logged and basic calculations are attempted, with limited analysis.	Little or no data is recorded; calculations and analysis are missing.
Sensors are successfully programmed to log data, though functionality is basic and occasional errors occur.	Basic programming is attempted; sensors are partially functional and data logging is inconsistent.	Little or no programming is attempted; sensor integration is missing or non-functional.
Actuators (e.g., motors, water pumps) are programmed to respond to sensor data, achieving basic automation.	Basic attempts to control actuators are made, but functionality is limited and unreliable.	There is no attempt to control actuators; no digital automation is evident.

Reflection and evaluation		
Self and group reflection	Deep, critical reflection offering detailed insights into personal learning, design evolution, and group collaboration, with suggestions for future improvements.	Clear, concrete reflection on design choices, experimental outcomes, and effective
SDG and sustainability integration		
Sustainability and SDG connection	Delivers an in-depth, insightful analysis connecting multiple project elements to sustainability principles and SDGs, highlighting technology's role in creating a sustainable future.	Clearly explains how the project supports sustainability and relates to specific SDGs (e.g., sustainable agriculture, efficient resource use) with concrete examples.
Integration of crosscutting concepts		
System thinking (viewing the terrarium/greenhouse as an interconnected system)	Offers an in-depth, insightful explanation of the greenhouse/terrarium as a complex, interdependent system with strong, concrete examples.	Clearly explains how different components work together as a system with relevant examples.
Cause and effect & stability and change (Understanding how changes affect plant growth and system performance)	Delivers a thorough analysis of cause-effect relationships, demonstrating critical thinking with detailed examples.	Provides clear examples of how specific design choices lead to changes in system performance.
Structure and function & scale and proportion (Designing the greenhouse using geometric principles)	Offers an exceptional explanation linking design, structural stability, and efficient use of space with well-justified examples.	Clearly explains the role of geometric design, scale, and proportion in creating a functional, stable greenhouse.
Stability and change (Interpreting data and understanding energy flows in the system)	Offers a comprehensive analysis of stability and change, demonstrating how iterative improvements lead to optimal system performance.	Clearly explains how small changes (e.g., in sensor placement or insulation) affect system stability and performance.
Patterns (and data analysis) (Interpreting sensor data and identifying trends in greenhouse conditions)	Presents a detailed and insightful analysis of sensor data, identifying clear trends and using the data to draw strong conclusions about the greenhouse environment.	Clearly explains trends in sensor data and connects these patterns to plant growth and environmental conditions.

- **Gathering and sharing information** (Relevant facts about plant growth, photosynthesis, sensor data, and geometric calculations)
- **Prototyping design, construction and testing** (Designing and building a greenhouse prototype/greenhouse, including environmental considerations)
- **Digital Skills:** Programming and automation (Programming

Basic reflection identifying strengths and weaknesses in design and collaboration.	Limited reflection with few insights; group dynamics are barely addressed.	No reflection or evaluation is provided.
Provides a basic link between project outcomes (e.g., energy-efficient greenhouse, effective water cycle) and sustainability/SDGs.	An SDG is mentioned, but the link is weak or unclear.	No sustainability or SDG connection is made.
Provides a basic analysis of how subsystems (structure, sensors, water management) interact.	Mentions system components, but with minimal explanation of their interrelations.	Little to no understanding of the system as a whole.
Explains basic cause and effect (e.g., how sensor readings or material changes affect plant growth).	Mentions cause-effect relationships with limited detail.	Does not address how modifications impact outcomes.
Provides a basic explanation of how shape and size influence greenhouse performance.	Mentions design elements with minimal connection to function or scale.	Little or no connection between design features and their functions.
Addresses basic stability issues when the system is modified.	Minimal discussion on the effect of design modifications.	No reflection on how changes affect stability.
Offers a basic analysis of sensor data and identifies some trends (e.g., changes in temperature or light intensity).	Provides a very limited description of sensor data with little reference to patterns.	Does not analyse sensor data or identify any patterns.

of sensors for data logging and control of actuators such as motors and water pumps)

- **Reflection and evaluation** (Reflection on experiments, design decisions, and group collaboration)
- **SDG and sustainability integration** (Connecting project outcomes to sustainability and SDG principles, including technology's role)
- **Integration of crosscutting concepts**

DETAILED LEVEL 3 CONTENT EVALUATION

This competency-based rubric aligns with the various project activities and ensures a clear assessment structure where teachers can indicate the student's level in each category by marking the corresponding star rating.

CRITERIA	5 STARS (EXCELLENT)	4 STARS (GOOD)
Gathering and sharing information		
Facts and data	Extensive and accurate data collected and convincingly shared in class/with peers.	Many relevant facts collected and clearly shared with peers.
Use of art to raise awareness		
Artistic contribution	Highly creative and well-thought-out use of art that powerfully reinforces the campaign message.	Art is effectively used with a clear link to raising awareness.
Campaign planning and design		
Plan and target audience	An excellent, detailed, and creative campaign plan with a clear audience definition and measurable success criteria.	A well-structured plan with clear strategies and target audience selection.
Reflection and evaluation		
Self-reflection	Deep and critical reflection with clear insights into personal and project growth.	Clear reflection with concrete insights and suggestions for improvement.
Research and SDG integration		
Research question and information	An outstanding, in-depth research question with an extensive collection of accurate facts, fully supported by reliable sources.	A well-formulated research question with multiple key facts and reliable, well-documented sources.
Connection to SDGs	SDG integration is excellent; the link between research and the SDG is deep and convincingly explained.	The chosen SDG is clearly linked to the research findings with a well-explained connection.

3 STARS (SATISFACTORY)	2 STARS (DEVELOPING)	1 STAR (NEEDS IMPROVEMENT)
Basic facts gathered and shared with peers.	Some facts collected, but lack structure and detail.	Few or no relevant facts gathered, unstructured.
Basic use of art; the connection to awareness is present but simple.	Some artistic elements are present but do not strongly support the message.	No or very little artistic elements included.
A clear plan with basic ideas on the audience and approach.	A basic plan is present but lacks details and a clear audience definition.	No clear planning or target audience defined.
Basic reflection; some strengths and weaknesses are identified.	Limited reflection with few concrete insights.	No reflection or evaluation of the process.
A clear research question with sufficient relevant facts and mostly reliable sources.	Research question is present but basic; some facts gathered with limited source referencing.	Research question is unclear and few facts collected; sources are missing.
An SDG is chosen with a basic explanation of why it is relevant to the research.	An SDG is mentioned, but the link is weak or unclear.	No connection to an SDG is made.

Presentation of research findings	An exceptional presentation with a creative and engaging format, where research findings and SDG connection are powerfully and insightfully communicated.	A well-organized presentation with a clear explanation and a suitable creative format (poster, infographic, etc.).
Integration of crosscutting concepts		
System thinking and patterns	Offers a detailed and insightful explanation of complex system interactions and recurring patterns with strong examples.	Clearly explains interactions among factors (water, waste, CO ₂ , land use) and identifies relevant patterns with examples.
Cause and effect & stability and change	Provides a thorough analysis of cause-effect relationships and critically discusses stability and change with strong examples.	Explains cause-effect relationships and discusses stability and potential changes clearly.
Structure and function & energy and matter	Offers an exceptional explanation linking artistic structure and resource flows powerfully to the campaign message.	Clearly explains how artistic structure enhances communication and describes energy/material flows effectively.

- **Facts and data** (About food and fast fashion: land use, water use, CO₂, waste, etc.)
- **Artistic Contribution** (How art is used to strengthen the message)
- **Plan and Target Audience** (Setting up a strategic plan and selecting a target audience)
- **Self-reflection** (Reflection on the process, execution, and personal growth)
- **Research question and information** (Quality of the research question and gathering of facts about biodiversity or social impact)
- **Connection to SDGs** (How research findings are linked to relevant SDGs and their importance)
- **Presentation of research findings** (Creative and clear communication of research findings, including SDGs)
- **Integration of crosscutting concepts** (Focus on research, discussion and campaign planning)

Clear presentation mentioning the SDG, though with limited creative effort.	Basic presentation, but lacks creativity and clarity.	Research findings are poorly or unclearly presented.
Provides a basic understanding of interactions and identifies some recurring patterns.	Briefly mentions interactions with minimal detail on patterns.	Does not address systems or patterns.
Addresses basic cause and effect and mentions stability and change.	Mentions cause and effect with limited explanation; little discussion on stability and change.	Does not address cause and effect or change.
Provides a basic explanation of how art and resource flows contribute to the project.	Mentions artistic methods or resource flows without a clear connection to the message.	Does not address structure, function, or resource flows.

APPENDIX D

SELF-ASSESSMENT

BLOCK	I CAN...
1. Science content	I can explain concepts and ideas related to science, technology, engineering, arts, or maths when relevant I can apply the concepts and ideas worked in the unit to design, test, or improve a product or solution I can connect what I have learned to real-world challenges and reflect on the results
2. English (L2)	I can use English to express my ideas clearly when writing or speaking I can use vocabulary and structures appropriate for the topic and task I can communicate effectively in English during group work and presentations
3. Critical thinking & creativity	I can suggest original or useful ideas to solve a problem or improve a product I can analyse a situation and make thoughtful decisions I can use creative strategies to share what I have learned
4. Teamwork & attitude	I can collaborate with others, listening and contributing respectfully I can stay organised and meet deadlines during the project I can show commitment and a positive attitude throughout the process
5. Digital skills	I can use digital tools to explore, create, or present content I can produce digital materials that are clear, well-designed and adapted to the purpose I can combine different media (text, image, sound...) to improve communication.
6. Sustainability	I can recognise the impact of human actions on the environment and society I can reflect on my role and make choices that promote sustainability I can take part in actions or solutions that contribute to a better future

Score

- 1 – Strongly disagree
- 2 – Disagree
- 3 – Neutral
- 4 – Agree
- 5 – Strongly agree

Description

- I don't know how to do this yet or I had a lot of trouble
- I can do it a bit, but I still need help or get confused
- I can do it sometimes, but I'm not very sure or confident
- I can usually do it well and I feel quite confident
- I can do it very well and feel confident in different situations

APPENDIX E

PEER-ASSESSMENT

I think my teammate(s)/I...	A1	A2	A3	A4	(Myself)
worked well with others and helped the group.					
shared ideas clearly and listened to the group.					
completed their part of the work on time.					
gave original and useful ideas to improve the project.					
had a positive attitude and encouraged others.					
respected other opinions and worked with everyone.					

*Write the name of each group member (including yourself) above A1–A5. Give a score from 1 (*Strongly disagree*) to 5 (*Strongly agree*) for each item.

APPENDIX F IMPLEMENTATION ASSESSMENT

Nº	INDICATOR	1	2	3	4	5
1	The project implementation is consistent combining CLIL, STEAM and storytelling in a coherent and integrated way.					
2	Activities foster active student participation and engagement throughout the learning process.					
3	Classroom management is effective, maintaining a positive and inclusive learning environment.					
4	Time is managed efficiently, allowing the planned activities to be completed within the available sessions.					
5	Unexpected challenges are addressed with flexible, reflective, and goal-aligned decisions.					
6	All students are actively involved, and individual needs are recognised and supported.					
7	The project encourages interdisciplinary connections and integrates different subjects in a meaningful and functional way.					
8	Co-teaching or interdisciplinary coordination (if applicable) is well-organised and contributes to the success of the project.					
9	Ongoing assessment is integrated into the project using varied tools and includes student self-reflection.					
10	The use of the L2 (if applicable) is consistent and functional across the project, supporting both communication and content learning.					
11	A final reflection is carried out, identifying achievements, challenges, and realistic adjustments for future implementations.					
TOTAL IMPLEMENTATION SCORE: /55						

Note:

Use the following scale to evaluate each indicator:

1 – Strongly disagree 2 – Disagree 3 – Neither agree nor disagree 4 – Agree 5 – Strongly agree

A SUSTAINABLE FUTURE NEEDS BRIGHT MINDS!

Don't Wait to See the Light! takes readers into a world where energy, innovation and sustainability shape everyday life. Through the story of Luz and her journey towards greater environmental awareness, this graphic novel encourages students to reflect on the impact of human choices on the planet and the importance of building a more sustainable future.

Inspired by this story of discovery and change, this teaching material combines reading, discussion and hands-on STEM activities to help students explore key issues related to renewable energy, sustainable design, responsible consumption and environmental awareness. Through experimentation, creativity and collaboration, students are encouraged to become active changemakers for a better tomorrow. . Step by step, they develop essential skills in critical literacy, scientific inquiry, creativity and social awareness, while also strengthening their communication skills in different languages.

This booklet, which includes four units and is designed according to the PROMISED model, provides teachers with a flexible, ready-to-use framework that connects literature, STEAM education and global citizenship. The material can be adapted to different teaching contexts, making it a versatile resource that fosters innovation in bilingual and multilingual classrooms. It includes practical activities, digital resources and assessment tools, all aligned with the challenges of global sustainability and marine conservation.

ABOUT THE PROJECT

PROMISED is an Erasmus+ project led by the University of Burgos in collaboration with Howest University, Matej Bel University, the University of Granada, the CFIE of Burgos, and Kveloce. Its goal is to design and implement an innovative didactic model that integrates STEAM education, bilingual learning (CLIL), sustainability, and digital skills in secondary schools, promoting both the green and digital transitions in education across Europe, to address the needs of 21st-century learners and support schools in facing today's educational challenges.

