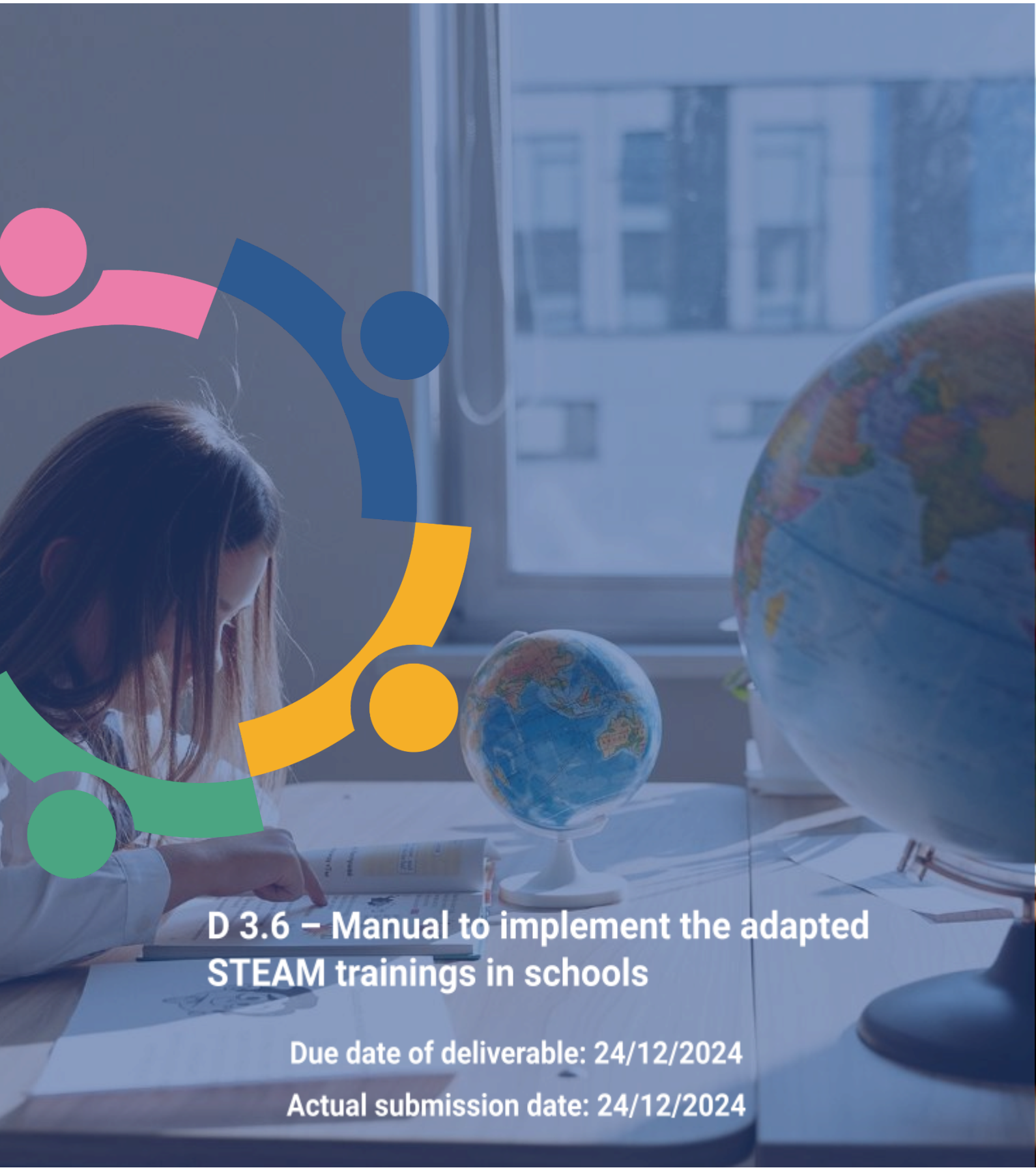

D 3.6 – Manual to implement the adapted STEAM trainings in schools

Due date of deliverable: 24/12/2024

Actual submission date: 24/12/2024

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Table of contents

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Technical References

Project number	101132652
Project title	STEAMBRACE - European coordination network and activities to embrace a sustainable and inclusive STEAM educational system: the blend of artistic and creative approaches in STEM education, research & innovation
Project duration	36 Months

Deliverable No.	D3.6
Dissemination level[1]	PP - Restricted to other programme participants
Work Package	WP3
Task	T3.6: Validation of the STEAM activities for schools at small-scale
Lead beneficiary	MPT
Contributing beneficiaries	ACINV
Due date of deliverable	24/12/2024
Actual submission date	24/12/2024

1 PU = Public
PP = Restricted to other programme participants (including the Commission Services)
RE = Restricted to a group specified by the consortium (including the Commission Services)
CO = Confidential, only for members of the consortium (including the Commission Services)

Document history

V	Date	Modifications	Author
V0	11/12/2024	First draft of the deliverable	ACINV
V1	18/12/2024	Previous work	ACINV
V2	19/12/2024	Modificactions and improvements	ACINV
V3	20/12/2024	Manuals of implementation	ACINV

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Abstract of Deliverable

This deliverable (D3.6) builds on the foundations established in the previous deliverable (D3.5), which introduced a set of draft STEAM activities developed using the STEAMbrace methodology. The methodology aimed to equip students aged 11-18 with essential STEAM skills while addressing gender, economic, and social disparities. The prior deliverable included 16 curriculum-based and 10 extracurricular STEAM activities, emphasising inclusivity and engagement.

In this iteration, the activities and their templates were refined based on expert consultations and methodology testing. Key improvements include unifying materials, reviewing session durations, and enhancing text clarity and presentation. A more user-friendly template was introduced to help teachers better understand and implement the activities.

Complementary resources have been developed, including:

- **Teacher's guide to STEAMbrace activities**: A detailed manual explaining how to use the activity templates and introducing the STEAMbrace methodology.
- **Teacher's guide to the STEAMbrace pilot**: A step-by-step implementation guide to assist educators in integrating the activities into their classrooms and collaborating with the project itself.

These resources aim to streamline the implementation process, ensuring teachers can effectively engage students in meaningful STEAM learning experiences. The deliverable also includes a visually enhanced **activity index** for easier navigation and selection of activities.

Disclaimer

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1. Previous works

The previous deliverable **D3.5** focused on Task 3.5, which aimed to equip students with essential STEAM skills through a gender-responsive approach that fosters equal participation and engagement. To achieve this, ACINV presented a set of draft STEAM activities based on insights and conclusions from earlier deliverables, including:

- **D3.1**: Description of STEAM trends in education systems across Europe
- **D3.3**: Database for the e-survey conducted with STEAM students
- **D3.4**: Current STEAM landscape in the academic curricula of students aged 11-18

The activities were developed using the newly introduced **STEAMbrace methodology**, grounded in established practices such as Gagné's methodology and project-based learning (PBL). This methodology specifically aimed to address the challenges identified in earlier deliverables.

That deliverable included:

An index of draft STEAM activities, featuring:

- 16 STEAM activities for school curricula
- 10 informal STEAM activities (non-academic)

Both sets targeted students aged 11-18, with half of the activities specifically designed to engage female students and ensure a balanced, inclusive approach to STEAM learning.

Building on the foundation established in the previous deliverable, the **current deliverable** (**D3.6**) will focus on improving the draft activities by refining their templates and presentations. This will include adding **comprehensive manuals** to facilitate easier implementation by teachers in classroom settings. The enhanced activities aim to better support educators in integrating STEAM practices while maintaining the gender-inclusive and student-focused approach of the STEAMbrace methodology.

2. Modifications and improvements:

a. Activities and templates

For the 26 activities delivered in the previous deliverable, after consulting with education experts and conducting a methodology review, this iteration focused on improving the following aspects:

- Unification of materials
- Review of session duration
- General review and refinement of texts and writing style

Additionally, we worked on enhancing the template used to present the activities, making it more user-friendly and accessible for teachers. This aims to ensure a smoother and more enjoyable process for educators when understanding the information provided for each activity.

Below you will find a **sample section** of an activity in the new template (this is not the complete activity, just the main parts so you can see how they were modified):

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Curricular

ROCKETS

Duration	Age	Difficulty
1,5 hrs or 2,5 hrs	11-12	Low
#SCIENCE #EXPERIMENTATION		

DESCRIPTION

Have you heard of ESA? What kind of relationship does your country have with this space agency? In this session we will become ESA aerospace engineers, with the mission to improve the prototype of a small rocket and find the optimal way to put it into orbit, using only a chemical reaction and variations of our experience by controlling variables. Are you ready to face this challenge? In addition, we will study about the astronaut corps, the first female astronauts and their history, and what it is like to spend time in space.

This session has two duration options: 2 or 3 hrs.

This is because it is divided into two parts that can be done independently of each other:

Experimentation with variable control (2 hr) and 'eyeballing' conclusions

Subsequent analysis of data with software (3 hr) and conclusions with 'good measurements'

ACTIVITY OBJECTIVES

- **Encourage teamwork**
- **Develop scientific curiosity**
- **Learn how to develop experiments with controlled variables and understand why it is important to change one variable at a time**
- **Understand how comparing experimental data allows us to draw conclusions about the behaviour of systems in nature**
- **(Optional - extended version) Become familiar with a digital environment for recording experimental data**

KEY COMPETENCES (EU)

- Numerical, scientific, and engineering skills
- Digital and technology-based competencies
- Interpersonal skills, and the ability to adopt new competencies

MATERIALS

Activity Kit
Provided by the teacher/institution
Downloadable Elements

PREVIOUS PREPARATION

- Creating working groups (2-3 participants)
- Preparing the materials
- (optional if long version is chosen) Installing 'Tracker' software on computers: https://physlets.org/tracker/
- Activity to be carried out in an open space, ideally with tables prepared to get dirty
- Setting up equipment/devices
- Approximately 4 rocket templates should be prepared per working group

CONTEXTUALIZATION AND ADAPTATION

If at this moment we drop a pencil, what happens: where does it fall to?
It will indeed fall to the ground, and so on with many other movements that we can predict very well in our environment. But what makes that movement predictable for us, and why do we know that it will fall to the ground? Surely the word gravity will ring a bell in this debate... In this session we will work on studying how the conditions of our environment change when we do not have it, or at least in very low percentage. For this we will study how astronauts live, who are part of the ESA body, a little of their history, and finally we will prepare our own rockets and we will test by controlling variables how we can make them more efficient.

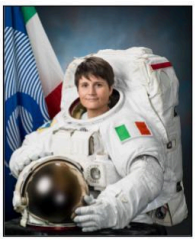
Note for the teacher 📝

Here are the answers corresponding to the previous blanks:

1. V-2
2. Nazi Germany
3. World War II
4. Vostok 1
5. Soviet Union
6. 1961
7. The Cold War
8. Yuri Gagarin
9. Apollo 11
10. Neil Armstrong

Now that we've talked a bit about rockets and how they work, can you imagine living without gravity? Let's think about basic everyday tasks; once we manage to overcome the earth's gravitational pull and stay floating, let's analyse how we could do the following things:

- Wash our teeth
- Take a shower
- Go to the bathroom
- Drink water



Here are some videos recorded by astronaut **Samantha Cristoforetti** who will explain in more detail what it's like to live in space for a while:

European Space Agency astronaut Samantha Cristoforetti, attired in an Extravehicular Mobility Unit (EMU) spacesuit. Photo credit: NASA. Photo link

Watch videos 📽️**:**

Hobbies on the Space Station | ESA Astronaut Samantha Cristoforetti

International Space Station bathroom tour

Where do astronauts sleep?

In any experiment we conduct, or any change in most situations, how do you think we should assess how a system responds to a change?:

By changing many things about that system at once? Or by changing one thing at a time?

Do you know what a control experiment or a **variable-controlled experiment** is?

For example, if we make a cake and we see that it does not turn out well, as good scientists we should experiment by changing the recipe to find out how to improve it. But could we modify it by changing the original amount of eggs and flour at the same time? In case the cake does indeed turn out better, what made it better: the amount of eggs or the amount of flour? We would not be sure, which is why when we change things in an experiment, it is important to change one thing at a time to be very sure how that change affects our 'cake' or experiment. This is called a 'variable-controlled experiment'.

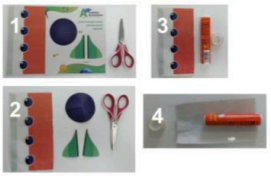
In today's session we will have to modify a rocket launch protocol to make the rockets fly even higher.

ACTIVITY

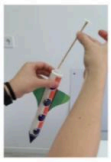
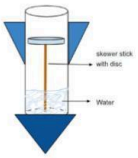
1. Groups of 3-4 students are formed (better to work in an open space)
2. Each group is given 1 rocket kit
3. The teacher will designate a group that will be in charge of carrying out the 'control experiment'. In order to 'standardise' it, a protocol is introduced that has already been tried and tested and is known to work. Although our aim is to improve it later, the control protocol will be as follows:
   - 15 ml of water
   - One whole, unground effervescent tablet
4. This group will do the '**initial launch**' and the rest should record approximately how long it takes to take off, how many metres it goes up, etc... For this it is useful to have a reference height; For example, stand next to a column that we know is X metres high.

Here's how to make the 'model' launch:

- The rocket template is cut out and mounted on the vitamin tube. It is important that the tip of the rocket goes from the closed part of the tube, so that our fuel can come out of the back of the tube. Then we go to an open place or a place that can get dirty.

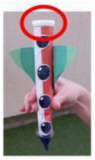


- We will give each group a wooden rod (like a skewer stick) and they will make a disc to stick on the end of it (it must be of a smaller diameter than the opening of the tube so that it can fit properly inside the cylinder; the image below shows the rod with disc but in this case instead of being made of cardboard it is made of plastic; it can be of any other material you consider) and they will place it as follows:

- We will hand out 1 effervescent tablet per group and ask them to place it on the disc. It is VERY IMPORTANT that no student knocks down the rocket in such a way that the walls or the disc get wet, otherwise it will start to react before it should.

- The rocket is then covered (without turning it upside down, i.e. with the open side always facing upwards), ensuring that it is vertical and that the water does not wet the walls. A little force is probably necessary as the wooden stick with the disc usually touches the bottom of the lid, and the lid must be very tightly closed. Then, we give them back to each group and ask them not to knock the rocket over.



Note for the teacher 📝

On the other hand, for our rocket, as it is covered (not open), all those CO_2 molecules that combine with the air, instead of being released into the atmosphere, start to accumulate inside the covered cylinder that we have prepared. There comes a point when the pressure inside the cylinder is so high, due to the amount of gas accumulated, that the same pressure causes the lid to fly off, as it is not sealed but a movable lid.

Why do you think we use the stick with the disc? We can leave some space for the children to answer what they think, and in general, they tend to answer correctly. The stick with the disc is so that when you put the tablet inside the disc, the reaction DOES NOT HAPPEN, because the tablet is isolated from the water at the bottom of the cylinder, and until we turn it over, there is no contact and the reaction does not occur. It is a way to be able to run the experiment more calmly and not have to do it all so quickly.

Error possibilities (support to the teacher's analysis)

What happens if a rocket doesn't fly? There are several factors that can affect this. It is a good opportunity to comment that experiments do not always go as expected and as scientists it is important to analyse why it did not succeed. You can even ask the children why they think it did not work. In general, it is usually due to the following reasons:

- The lid was not tightly closed, so some gas escaped and the pressure was not high enough for the lid to open by itself.
- The rocket was knocked over and the walls were wet, or even the disc was wet, so the reaction would have started before the rocket was covered and a lot of air would have been lost to the atmosphere.
- Some of the tablets are a bit old or wet and do not have as much effervescent effect.

CONCLUSION AND SHARING

- What have you learned?
- How did you learn it?
- What was the easiest/hardest for you?

Debate in groups 🗣

What kind of change of variables was most effective in making the rocket fly higher?

Would you think of applying this method of controlling variables to other aspects of our surroundings?

If you had to modify the experimental process to make it more efficient, what would you do?

What did you know about ESA astronauts before this session, and what has caught your attention?

We suggest you share your results in social media by tagging STEAMbrace project:

LinkedIn Instagram X

PROJECT EVALUATION

Activity Objectives	Key Competences (EU)	Evaluation Criteria
Encourage teamwork.	Interpersonal skills, and the ability to adopt new competencies	The ability of the group to collaborate effectively, showing good communication, task sharing and mutual support to achieve the objectives of the activity will be assessed.
Develop scientific curiosity.		Students' ability to ask questions, actively explore experimental variables, and show interest in understanding and improving the experiment will be assessed.
Learn to develop experiments controlling variables and understand why it is important to change one variable at a time.	Numerical, scientific, and engineering skills	Understanding and applying the concept of variable control in the design and execution of experiments will be assessed, as well as the ability to justify the importance of modifying only one variable at a time to obtain conclusive results, e.g. by analysing and identifying patterns and trends, formulating conclusions based on experimental evidence, recording experimental data, etc.
Understand how comparing experimental data allows us to draw conclusions about the behaviour of systems in nature.		
Become familiar with a digital environment for recording experimental data.	Digital and technology-based competencies	Be able to organise data in a structured way in the digital environment (with the proposed software), using graphs, tables or other means to improve the visualisation and comparison of results, thus being able to analyse data and detect patterns, facilitating the interpretation of experimental results. They can explain the advantages of using a digital environment to record data (accuracy, ease of comparison, etc.) and reflect on how technology improves the scientific research process.

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As you may see, all the sections presented in the previous deliverables for the activities have been maintained but upgraded in a more visual way, making it easier for the teacher to identify the different parts and better prepare materials, steps, evaluations, etc.

You may find the new activities templates available for download in: 003_Updated activities

b. Activity index

To improve the **activity index**, we have transitioned to a format where it can be downloaded as PDF, with all information presented in a highly visual way. This approach enables teachers to quickly find the activities they are most interested in delivering to their students.

Additionally, this format makes it easier for teachers to communicate which activities they have chosen to implement.

Below is a sample section from the mentioned index:

Ages	Difficulty	Curricula associated	Session name	Type	Topics	Areas covered	Description
11-12	Easy	✓	New Species	Connected activity	AI/IN		The activity focuses on teaching species identification and classification using decision trees and the concept of taxonomy. Students will apply these skills to complex or unfamiliar animals and explore the use of artificial intelligence to create and classify new species.
11-12	Easy	EXTRA	Trapped heat	Hands on activity	E/IN		This experiment explores the greenhouse effect by comparing how two gases, including CO2, respond to heat. By analyzing their heat capacities, participants will better understand the greenhouse effect and learn how to analyze experimental data to draw meaningful conclusions.

S T E A M

RO	Robotics	AI	Artificial Intelligence
G	Games	E	Experimentation
C	Craft	SA	Safety
AR	Augmented reality	IN	Information
AV	Audiovisual	3D	3D modeling

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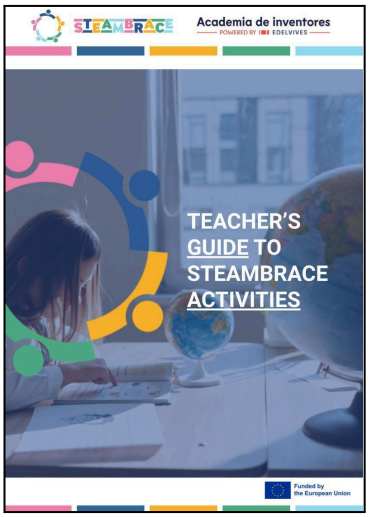
You may find the file in: 002_Updated activity index

3. How to understand the STEAMbrace method: Teacher's guide to STEAMbrace activities (NEW)

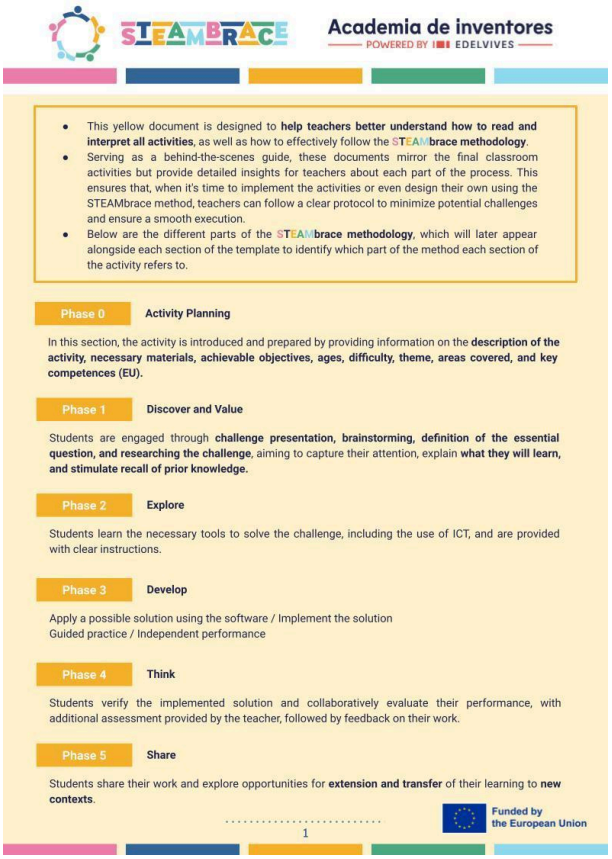


To facilitate teacher's understanding of the activities proposed in the STEAMbrace program and familiarize them with the methodology, a complementary resource called the **"Teacher's Guide to STEAMbrace Activities"** has been developed. The purpose of this guide is to explain **"how to understand the activity templates"** and provide a brief introduction to the STEAMbrace method.

In this guide, teachers will find a **"mirror"** of the activity templates, but with the difference that it serves as a **"backstage"** resource designed specifically for educators. It explains, based on the proposed methodology, how to approach each part of the activity and what each section represents. This guide is designed to serve as a practical tool, helping teachers effectively engage with and implement the STEAMbrace method.

You may find this guide in this directory and as an annex at the end: 001_Teacher's guide to STEAMbrace activities

Below you will find a preview of the document: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- This yellow document is designed to **help teachers better understand how to read and interpret all activities**, as well as how to effectively follow the STEAMbrace methodology.
- Serving as a behind-the-scenes guide, these documents mirror the final classroom activities but provide detailed insights for teachers about each part of the process. This ensures that, when it's time to implement the activities or even design their own using the STEAMbrace method, teachers can follow a clear protocol to minimize potential challenges and ensure a smooth execution.
- Below are the different parts of the STEAMbrace methodology, which will later appear alongside each section of the template to identify which part of the method each section of the activity refers to.

Phase 0 Activity Planning

In this section, the activity is introduced and prepared by providing information on the **description of the activity, necessary materials, achievable objectives, ages, difficulty, theme, areas covered, and key competences (EU).**

Phase 1 Discover and Value

Students are engaged through **challenge presentation, brainstorming, definition of the essential question, and researching the challenge**, aiming to capture their attention, explain **what they will learn, and stimulate recall of prior knowledge.**

Phase 2 Explore

Students learn the necessary tools to solve the challenge, including the use of ICT, and are provided with clear instructions.

Phase 3 Develop

Apply a possible solution using the software / Implement the solution
Guided practice / Independent performance

Phase 4 Think

Students verify the implemented solution and collaboratively evaluate their performance, with additional assessment provided by the teacher, followed by feedback on their work.

Phase 5 Share

Students share their work and explore opportunities for **extension and transfer** of their learning to **new contexts**.

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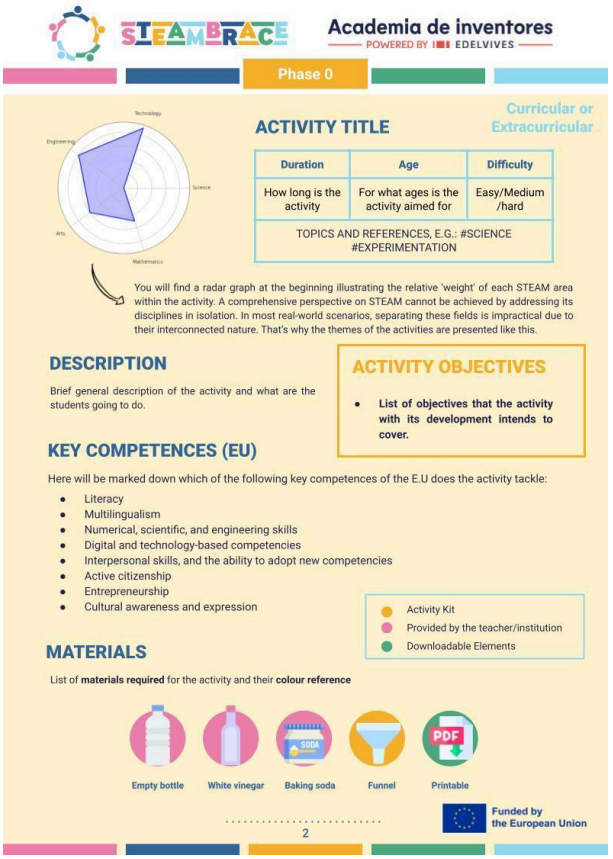
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Phase 0

ACTIVITY TITLE

Curricular or Extracurricular

Duration	Age	Difficulty
How long is the activity	For what ages is the activity aimed for	Easy/Medium /hard
TOPICS AND REFERENCES, E.G.: #SCIENCE #EXPERIMENTATION		

You will find a radar graph at the beginning illustrating the relative 'weight' of each STEAM area within the activity. A comprehensive perspective on STEAM cannot be achieved by addressing its disciplines in isolation. In most real-world scenarios, separating these fields is impractical due to their interconnected nature. That's why the themes of the activities are presented like this.

DESCRIPTION

Brief general description of the activity and what are the students going to do.

ACTIVITY OBJECTIVES

- List of objectives that the activity with its development intends to cover.

KEY COMPETENCES (EU)

Here will be marked down which of the following key competences of the E.U does the activity tackle:

- Literacy
- Multilingualism
- Numerical, scientific, and engineering skills
- Digital and technology-based competencies
- Interpersonal skills, and the ability to adopt new competencies
- Active citizenship
- Entrepreneurship
- Cultural awareness and expression

Activity Kit
Provided by the teacher/institution
Downloadable Elements

MATERIALS

List of **materials required** for the activity and their **colour reference**

Empty bottle · White vinegar · Baking soda · Funnel · Printable

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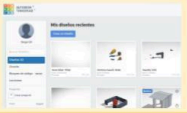
Phase 0

PREVIOUS PREPARATION

At this point, the guidelines that the teacher must follow in case they need to configure any element, such as creating a work group in Tinkercad or dividing the students in groups,, are outlined.



Phase 1

CONTEXTUALIZATION AND ADAPTATION

Here goes an **introduction to the activity and a section to give context to what students are going to learn in this session**.

This section provides a **theoretical introduction along with context and motivation** for the activity. Relatable situations are presented to help students connect with their reality, fostering engagement and curiosity to drive the activity forward.

To support our previous statements, each session will introduce problems, issues, or themes within a context that includes **relevant situations and information**, as much as possible. This approach helps students connect with the topic and engage meaningfully with the activity. This will be achieved (when the topic aligns well with this approach) by one or more of the following initiatives proposed to them:

- Providing introductory content that encourages students to relate the material to their surroundings
- Apply what they've learned to real-life situations
- Consider other scenarios
- Challenge prior assumptions
- Reflect on how the topic might impact their future

You will also find throughout this "teacher's backstage" reminders of **Gagné's** events and examples of how to apply them, as the **STEAMbrace methodology** is inspired by these events along with **challenge-based learning**.

CAPTURE INTEREST

We can start by using one of these three questions:

- What makes the ideal participant in your course feel curious?
- What gives them a sense of self-sufficiency?
- What do they want to achieve in their career?

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Phase 1

TELL THEM WHAT THEY ARE GOING TO LEARN

Each lesson should have a clear learning objective. Once we have captured their attention, what powerful, effective, and meaningful learning (for them) are we going to offer?

Tell them what the students will be able to do as a result of this lesson.

STIMULATE RECALL OF PRIOR KNOWLEDGE

Concepts are not learned from scratch; it is very important to highlight prior knowledge to connect it with the new content. Depending on the prior knowledge, the information can be presented in two ways:

- Useful prior information: In this case, we will recall the prior knowledge to prepare them to absorb the new content.
- Incorrect prior information: In this case, we can start from the premise of 'Everything you know about the moon is wrong!' and then present the real knowledge.

Below are some "boxes" of activities and additional information related to the context of the activity that you may find in this section. These are optional, but the facilitator or teacher who wishes to implement them may do so. Depending on the type of activity, these boxes are distinguished by different colors: **classroom supplementary activity**, **complementary tools/exercises**, and **notes for the teacher.** Each of these categories is explained in detail below.

Box for complementary tools and exercises, for example:
Watch video 📽 - "Video title" + link

Classroom activity 💡

A proposal to the teacher to complement the theory and information that is being given.

Note for the teacher 📝

This box could be used to either give the solutions of "classroom activities" to the teacher or to highlight some important parts of the activity for example things that should be taken into account or tips.

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Phase 2-3

ACTIVITY

Development of the main activity with the objective tools and issues to tackle.

Here may also be used the "**Note for the teacher** 📝" box in order to specify something about the steps of the activity or anything relevant to its development. In this part, you may also find tutorials or complementary activities.

Some **tips** on how to approach this section:

PRESENT THE INSTRUCTION

Depending on the specific learning objective, **the information should be presented differently based on the type of learning**. Some interesting approaches are:

- Present verbal information in small segments.
- Provide relevant graphics to give context.
- Present useless and ineffective attitude options that the student MIGHT adopt (and their harmful long-term effects).
- Present the correct (target) attitude choice (and its long-term benefits).
- Present the concepts (big ideas) that students need to understand to perform the skill.
- Present the tools and resources that students must have to perform the skill.
- Guide students through the specific steps involved in performing the skill.

GUIDED PRACTICE

Whenever possible, **guided practice should be conducted to internalize and correctly use the knowledge presented**.

The important point in guided practice is to make sure you are truly providing guidance and not just asking students to perform the activity on their own, which is the NEXT step.

INDEPENDENT PERFORMANCE

At this point, the student will test the acquired knowledge by performing the activity on their own. Even so, the teacher will provide guidelines and create the necessary space for the student to practice safely.

It is very important for students to perform the skill by themselves because doing so generates a sense of self-efficacy.

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Phase 4-5

CONCLUSION AND SHARING

Closure of the activity, here you may also find the "Classroom activity 💡" box with complementary questions, dynamics, or debate proposals that the teacher may use that are helpful for making conclusions with the participants about the activity and its content.

FEEDBACK

Once the previous phase is completed, it should be determined whether they have successfully performed the activity on their own.

- Self-reflective feedback
- Peer feedback
- Instructor comments
- Automated feedback

EVALUATION

When planning your **lesson evaluation**, don't assume it must be a quiz. For example, in a lesson on baking a chocolate cake, a quiz won't show if students have gathered the ingredients, but a photo of them laid out on the kitchen table would. This also applies to the STEAM activities presented.

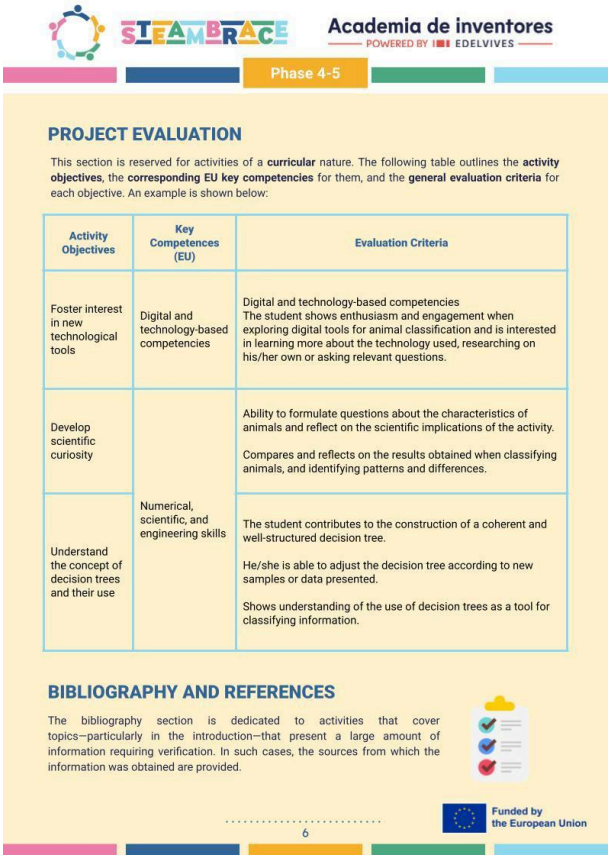
There will be boxes with suggestions of evaluation for each activity depending on its dynamic.

EXTENSION AND TRANSFER

Once it is determined that the participants have indeed achieved the intended learning, they should be encouraged to use their learning in **other contexts**.

Also, the project's **social media** will be linked in this section in case whoever makes the activity wants to share their results. They will be presented like this:

LinkedIn Instagram X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Phase 4-5

PROJECT EVALUATION

This section is reserved for activities of a **curricular** nature. The following table outlines the **activity objectives**, the **corresponding EU key competencies** for them, and the **general evaluation criteria** for each objective. An example is shown below:

Activity Objectives	Key Competences (EU)	Evaluation Criteria
Foster interest in new technological tools	Digital and technology-based competencies	Digital and technology-based competencies The student shows enthusiasm and engagement when exploring digital tools for animal classification and is interested in learning more about the technology used, researching on his/her own or asking relevant questions.
Develop scientific curiosity	Numerical, scientific, and engineering skills	Ability to formulate questions about the characteristics of animals and reflect on the scientific implications of the activity. Compares and reflects on the results obtained when classifying animals, and identifying patterns and differences.
Understand the concept of decision trees and their use		The student contributes to the construction of a coherent and well-structured decision tree. He/she is able to adjust the decision tree according to new samples or data presented. Shows understanding of the use of decision trees as a tool for classifying information.

BIBLIOGRAPHY AND REFERENCES

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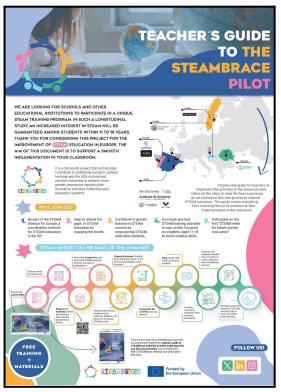
4. How to implement these activities in the classroom: Teacher's guide to STEAMbrace pilot (NEW)



This section focuses on the creation of a **teacher's guide**, designed to assist educators in successfully implementing the STEAMbrace pilot activities in their classrooms while collaborating with STEAMbrace and its partners.

The guide aims to provide teachers with a clear and detailed **step-by-step process** to facilitate their understanding of the activities and their effective integration into the curriculum. It includes practical instructions on how, why, and when to carry out the activities, emphasising simplicity and ease of use for educators. You may find this file in: 000_Teacher's guide to STEAMbrace pilot

Some **key contents of the teacher's guide**:

- **Introduction to the STEAMbrace Project:**
  A concise summary of the program's goals, focusing on increasing interest in STEAM among students aged 11-18 while addressing gender, economic, and social disparities.

- **Step-by-Step Instructions:**
  A detailed outline of the implementation process, covering:
  - Access to the activity index and selection of activities.

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- Familiarization with the STEAMbrace methodology through the "teacher's guide to STEAMbrace activities".
- Instructions for downloading and preparing session materials, with a focus on pre-lesson preparations.

- **Implementation and Feedback:**
  Guidelines for effectively integrating activities into the classroom.

- **Collaboration with the Project:**
  An explanation of the teacher's role in periodic evaluations, including participation in surveys and interviews with STEAMbrace partners to provide insights for refining activities.

- **Resource Management:**
  Clear instructions for requesting necessary materials via a streamlined process to ensure efficiency and organization.

This structure highlights the essential information offered to teachers, ensuring they have a clear roadmap for successfully participating in the pilot program and fostering collaboration between educators and the project team.

It is of special importance to mention in this section the implementation of a **material request protocol through a QR code via Google Forms.**

Teachers can use this QR code to access a form where they will provide the following information (this QR is also available in the infographic):

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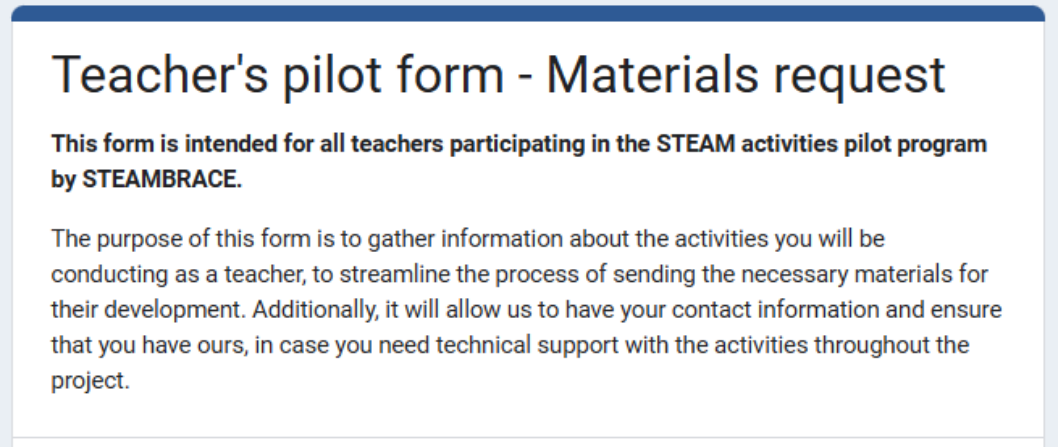
This form is designed for all teachers participating in the STEAMbrace pilot program.

The primary goal of this form is to collect information about the activities teachers plan to conduct, ensuring a smooth process for sending the necessary materials. Additionally, it serves to establish a direct line of communication between the teachers and the STEAMbrace team, allowing for ongoing technical support throughout the activities.

The form has at the beginning a brief introduction for the teachers in order to know why they are being asked this information:


Teacher's pilot form - Materials request

This form is intended for all teachers participating in the STEAM activities pilot program by STEAMBRACE.

The purpose of this form is to gather information about the activities you will be conducting as a teacher, to streamline the process of sending the necessary materials for their development. Additionally, it will allow us to have your contact information and ensure that you have ours, in case you need technical support with the activities throughout the project.

Information asked in this form is the following:

- Institution/school
- Country
- School address (Street name, Street number, City, Postal code, Region/State)
- Teacher's complete name
- E-mail address (primary contact info)
- The age range of students that will implement the activities
- How many students are going to be involved?
- Multiple selection of which activities are going to be implemented

This protocol ensures an efficient and supportive framework for teachers, enabling them to fully engage with the program's objectives and resources.

To emphasize, this form **is not intended to coordinate schools but to provide teachers with purely technical assistance** throughout the implementation of the activities and to ensure the delivery of materials. The comprehensive management of schools is not within the scope of this deliverable.

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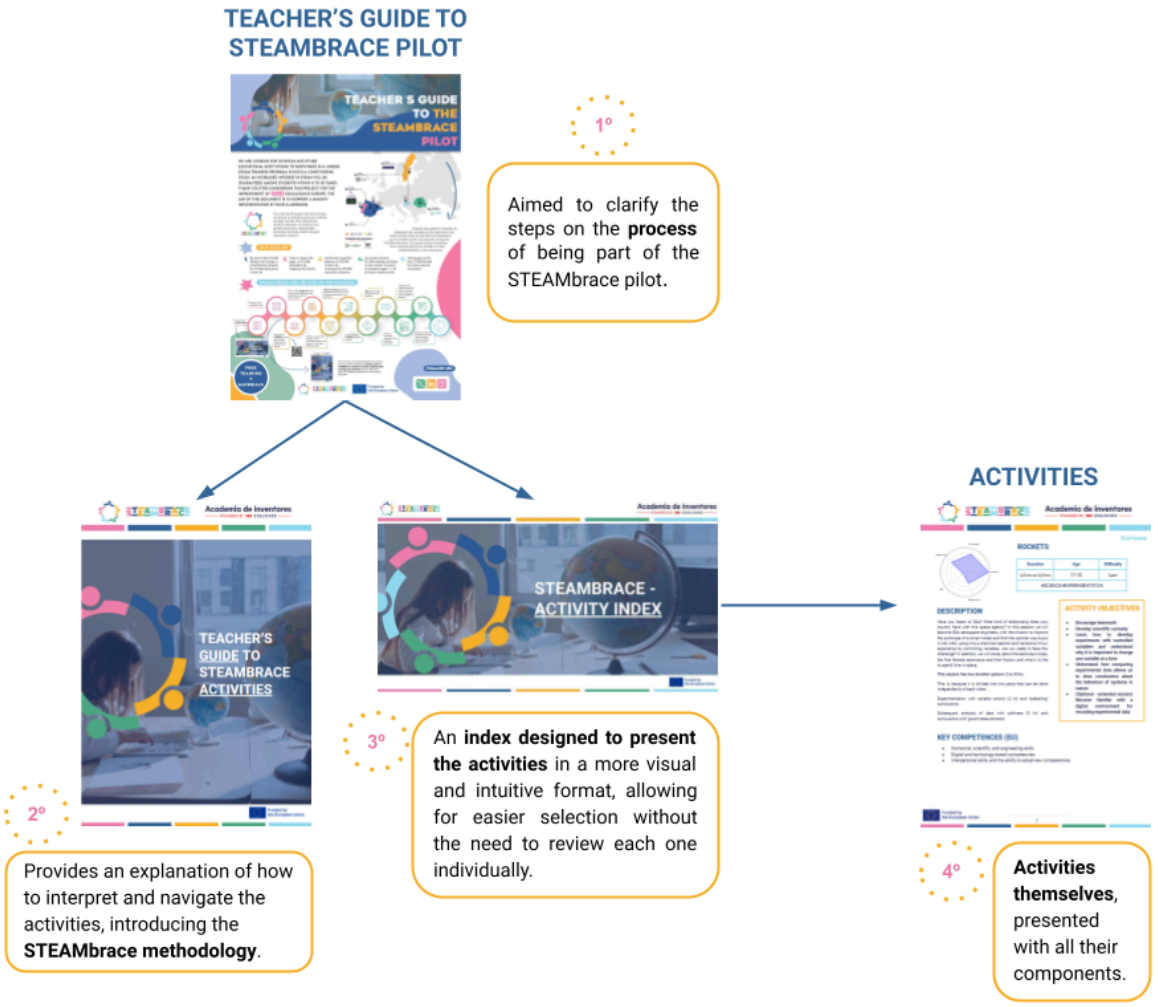
5. Review of new manuals and their connection

We could trace a relation between all of these manuals and protocols and see how they are interconnected:



All in all, with all these documents, the aim is to create a clear and practical roadmap for teachers, serving as both a guide and an incentive to implement these sessions in the classroom. By providing structured resources and easy-to-follow instructions, the objective is to empower educators to engage their students in meaningful and inclusive STEAM learning experiences while seamlessly integrating the STEAMbrace methodology into their teaching practices.

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Annex: Manuals and documentation

Order of appearance:

1. Teacher's guide to STEAMbrace pilot
2. Teacher's guide to STEAMbrace activities
3. Activity index

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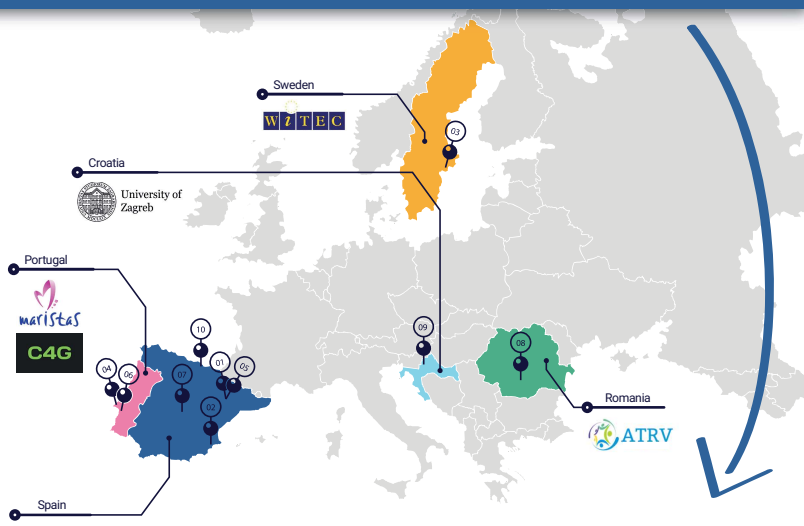
TEACHER´S GUIDE TO THE STEAMBRACE PILOT

WE INVITE SCHOOLS AND EDUCATIONAL INSTITUTIONS TO JOIN A GROUNDBREAKING STEAM TRAINING PROGRAM. THIS INITIATIVE OFFERS A UNIQUE OPPORTUNITY TO PARTICIPATE IN A LONG-TERM STUDY AIMED AT ENHANCING YOUNG STUDENT´S (AGES 11-18) INTEREST IN STEAM AND IMPROVING THEIR SKILLS IN THESE FIELDS. THIS DOCUMENT SERVES AS A GUIDE TO HELP YOU NAVIGATE THE STEAMBRACE PILOT PROGRAM, ENSURING A SMOOTH STEP-BY-STEP IMPLEMENTATION IN THE CLASSROOM.

STEAMBRACE

It is a 36-month project that will strongly contribute to mobilizing Europe's cultural heritage and the EU's cultural and creative industries to achieve more gender-responsive reproducible innovative activities within Europe's education systems.



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Step-by-step guide for teachers to implement the activities in the classroom and follow all the steps to have the best experience as we embark on this new journey to improve STEAM education. This guide covers everything from receiving the list of activities to their implementation in the classroom.

WHY JOIN US?

1. Be part of the STEAM Alliance for Europe, a coordination network for STEAM educacion in the EU!
2. Help to reduce the gaps in STEAM education by mapping the trends.
3. Contribute to gender balance in STEAM careers by empowering STEAM education systems.
4. Co-create and test STEAM training activities in your center. Focused on students aged 11-18 to boost creative skills.
5. Participate on the first "STEAM week for future women innovators"

STEAM NEEDS YOU. BE PART OF THE CHANGE!

Receive the **activity Index**

Choose which activities to do

Request the **materials**, review, and decide if those are the activities you will do.

Fill out the **Google form** with your contact details and the activities you plan to participate in.

Written consent from families will be collected. Students will take a 10-15 minute STEAM survey.

Prepare the lesson: Practice beforehand and focus on the "previous preparation in the activities."

Incorporate the activities into your classes

Enjoy the STEAM training with your students

Evolving conscious students in this amazing experience

Teachers will evaluate activities after 2 months in a short interview with STEAMbrace partners.

Continue using the activities if you like, and we'll stay in touch for further improvements.

If it's the first time doing STEAMbrace activities we recommend reading the **teacher's guide to STEAMbrace activities to better understand the way they are presented**, how to implement them (STEAMbrace method) and which parts they have.

FREE TRAINING + MATERIALS

FOLLOW US!

STEAMBRACE

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STEAMBRACE

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TEACHER'S GUIDE TO STEAMBRACE ACTIVITIES

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- This yellow document is designed to **help teachers better understand how to read and interpret all activities**, as well as how to effectively follow the **STEAMbrace methodology**.
- Serving as a behind-the-scenes guide, these documents mirror the final classroom activities but provide detailed insights for teachers about each part of the process. This ensures that, when it's time to implement the activities or even design their own using the STEAMbrace method, teachers can follow a clear protocol to minimize potential challenges and ensure a smooth execution.
- Below are the different parts of the **STEAMbrace methodology**, which will later appear alongside each section of the template to identify which part of the method each section of the activity refers to.

Phase 0 Activity Planning

In this section, the activity is introduced and prepared by providing information on the **description of the activity, necessary materials, achievable objectives, ages, difficulty, theme, areas covered, and key competences (EU).**

Phase 1 Discover and Value

Students are engaged through **challenge presentation, brainstorming, definition of the essential question, and researching the challenge**, aiming to capture their attention, explain **what they will learn, and stimulate recall of prior knowledge.**

Phase 2 Explore

Students learn the necessary tools to solve the challenge, including the use of ICT, and are provided with clear instructions.

Phase 3 Develop

Apply a possible solution using the software / Implement the solution
Guided practice / Independent performance

Phase 4 Think

Students verify the implemented solution and collaboratively evaluate their performance, with additional assessment provided by the teacher, followed by feedback on their work.

Phase 5 Share

Students share their work and explore opportunities for **extension and transfer** of their learning to **new contexts**.

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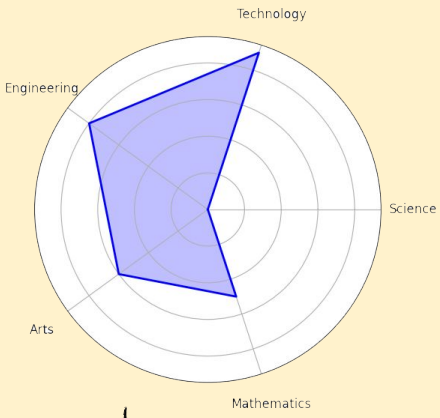

ACTIVITY TITLE

Curricular or Extracurricular

Duration	Age	Difficulty
How long is the activity	For what ages is the activity aimed for	Easy/Medium /hard
TOPICS AND REFERENCES, E.G.: #SCIENCE #EXPERIMENTATION		

You will find a radar graph at the beginning illustrating the relative 'weight' of each STEAM area within the activity. A comprehensive perspective on STEAM cannot be achieved by addressing its disciplines in isolation. In most real-world scenarios, separating these fields is impractical due to their interconnected nature. That's why the themes of the activities are presented like this.

DESCRIPTION

Brief general description of the activity and what are the students going to do.

ACTIVITY OBJECTIVES

- **List of objectives that the activity with its development intends to cover.**

KEY COMPETENCES (EU)

Here will be marked down which of the following key competences of the E.U does the activity tackle:

- Literacy
- Multilingualism
- Numerical, scientific, and engineering skills
- Digital and technology-based competencies
- Interpersonal skills, and the ability to adopt new competencies
- Active citizenship
- Entrepreneurship
- Cultural awareness and expression

- Activity Kit
- Provided by the teacher/institution
- Downloadable Elements

MATERIALS

List of **materials required** for the activity and their **colour reference**

Empty bottle | White vinegar | Baking soda | Funnel | Printable

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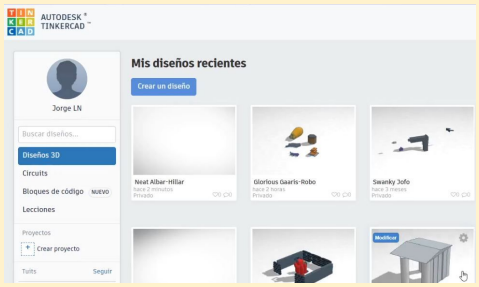
Phase 0

PREVIOUS PREPARATION

At this point, the guidelines that the teacher must follow in case they need to configure any element, such as creating a work group in Tinkercad or dividing the students in groups,, are outlined.



Phase 1

CONTEXTUALIZATION AND ADAPTATION

Here goes an **introduction to the activity and a section to give context to what students are going to learn in this session**.

This section provides a **theoretical introduction along with context and motivation** for the activity. Relatable situations are presented to help students connect with their reality, fostering engagement and curiosity to drive the activity forward.

To support our previous statements, each session will introduce problems, issues, or themes within a context that includes **relevant situations and information**, as much as possible. This approach helps students connect with the topic and engage meaningfully with the activity. This will be achieved (when the topic aligns well with this approach) by one or more of the following initiatives proposed to them:

- **Providing introductory content that encourages students to relate the material to their surroundings**
- **Apply what they've learned to real-life situations**
- **Consider other scenarios**
- **Challenge prior assumptions**
- **Reflect on how the topic might impact their future**

You will also find throughout this "teacher's backstage" reminders of **Gagné's** events and examples of how to apply them, as the **STEAMbrace methodology** is inspired by these events along with **challenge-based learning**.

CAPTURE INTEREST

We can start by using one of these three questions:

- What makes the ideal participant in your course feel curious?
- What gives them a sense of self-sufficiency?
- What do they want to achieve in their career?

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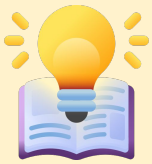
TELL THEM WHAT THEY ARE GOING TO LEARN

Each lesson should have a clear learning objective. Once we have captured their attention, what powerful, effective, and meaningful learning (for them) are we going to offer?

Tell them what the students will be able to do as a result of this lesson.

STIMULATE RECALL OF PRIOR KNOWLEDGE



Concepts are not learned from scratch; it is very important to highlight prior knowledge to connect it with the new content. Depending on the prior knowledge, the information can be presented in two ways:

- Useful prior information: In this case, we will recall the prior knowledge to prepare them to absorb the new content.
- Incorrect prior information: In this case, we can start from the premise of 'Everything you know about the moon is wrong!' and then present the real knowledge.

Below are some "boxes" of activities and additional information related to the context of the activity that you may find in this section. These are optional, but the facilitator or teacher who wishes to implement them may do so. Depending on the type of activity, these boxes are distinguished by different colors: **classroom supplementary activity**, **complementary tools/exercises**, and **notes for the teacher.** Each of these categories is explained in detail below.

Box for complementary tools and exercises, for example:
Watch video 📽️ - "Video title" + link

Classroom activity 💡

A proposal to the teacher to complement the theory and information that is being given.

Note for the teacher 📝

This box could be used to either give the solutions of "classroom activities" to the teacher or to highlight some important parts of the activity for example things that should be taken into account or tips.

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ACTIVITY

Development of the main activity with the objective tools and issues to tackle.

Here may also be used the "**Note for the teacher** 📝" box in order to specify something about the steps of the activity or anything relevant to its development. In this part, you may also find tutorials or complementary activities.

Some **tips** on how to approach this section:

PRESENT THE INSTRUCTION

Depending on the specific learning objective, **the information should be presented differently based on the type of learning**. Some interesting approaches are:

- Present verbal information in small segments.
- Provide relevant graphics to give context.
- Present useless and ineffective attitude options that the student MIGHT adopt (and their harmful long-term effects).
- Present the correct (target) attitude choice (and its long-term benefits).
- Present the concepts (big ideas) that students need to understand to perform the skill.
- Present the tools and resources that students must have to perform the skill.
- Guide students through the specific steps involved in performing the skill.

GUIDED PRACTICE

Whenever possible, **guided practice should be conducted to internalize and correctly use the knowledge presented**.

The important point in guided practice is to make sure you are truly providing guidance and not just asking students to perform the activity on their own, which is the NEXT step.

INDEPENDENT PERFORMANCE

At this point, the student will test the acquired knowledge by performing the activity on their own. Even so, the teacher will provide guidelines and create the necessary space for the student to practice safely.

It is very important for students to perform the skill by themselves because doing so generates a sense of self-efficacy.

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CONCLUSION AND SHARING

Closure of the activity, here you may also find the "Classroom activity 💡" box with complementary questions, dynamics, or debate proposals that the teacher may use that are helpful for making conclusions with the participants about the activity and its content.

FEEDBACK

Once the previous phase is completed, it should be determined whether they have successfully performed the activity on their own.

- Self-reflective feedback
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EVALUATION

When planning your **lesson evaluation**, don't assume it must be a quiz. For example, in a lesson on baking a chocolate cake, a quiz won't show if students have gathered the ingredients, but a photo of them laid out on the kitchen table would. This also applies to the STEAM activities presented.

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EXTENSION AND TRANSFER

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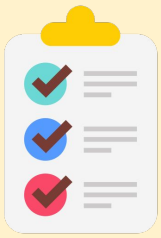

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STEAMBRACE - ACTIVITY INDEX

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Ages	Difficulty	Curricula associated	Session name	Type	Topics	Areas covered	Description
11-12	Easy	✓	**New Species**	Connected activity	AI/IN		The activity focuses on teaching species identification and classification using decision trees and the concept of taxonomy. Students will apply these skills to complex or unfamiliar animals and explore the use of artificial intelligence to create and classify new species.
11-12	Easy	EXTRA	**Trapped heat**	Hands on activity	E/IN		This experiment explores the greenhouse effect by comparing how two gases, including CO2, respond to heat. By analyzing their heat capacities, participants will better understand the greenhouse effect and learn how to analyze experimental data to draw meaningful conclusions.

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RO	Robotics	**AI**	Artificial Intelligence
G	Games	**E**	Experimentation
C	Craft	**SA**	Safety
AR	Augmented reality	**IN**	Information
AV	Audiovisual	**3D**	3D modeling

STEAMBRACE

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Ages	Difficulty	Curricula associated	Session name	Type	Topics	Areas covered	Description
11-12	Easy	✓	**Rockets**	Hands on and connected activity	E/IN		This activity involves working as ESA aerospace engineers to design and launch chemically propelled rockets, focusing on controlled variables. Participants will explore their countries' connections to space exploration, improve rocket prototypes, and learn about the history of astronauts, including the first women in space. The experience combines teamwork, scientific analysis, and an understanding of rocket propulsion physics.
11-12	Easy	✓	**Training AI**	Hands on activity	AI/IN/SA		This activity introduces Artificial Intelligence (AI) and programming through interactive challenges. Participants will learn how AI works, how it differs from traditional programs, and the importance of clear instructions in programming. Using Scratch and Machine Learning for Kids, they will train an AI model to classify passwords by security level, gaining expertise in digital security and AI applications.

RO	Robotics	**AI**	Artificial Intelligence
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STEAMBRACE

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Ages	Difficulty	Curricula associated	Session name	Type	Topics	Areas covered	Description
11-12	Medium	✓	**Inventors in history**	Hands on and connected activity	AI/RO/IN		This activity explores inventions and their creators, highlighting both male and female inventors. Students will reflect on how these innovations have shaped the world and develop creative solutions for future challenges. Using the mBlock programming platform and the Cirkids kit, students will create projects that link inventions to their inventors, combining research, programming, and robotics. This approach enhances technological and manual skills while fostering an innovative mindset.
11-12	Easy	EXTRA	**Hacking street furniture**	Connected activity	3D		In this activity, students will explore how to improve urban furniture in their city through 3D design. They will start by analyzing public trash bins to identify ways to make them more functional and sustainable. Then, using the Tinkercad platform and paper prototypes, they will create and test their own redesign ideas. This activity encourages creativity and critical thinking, using technology to find practical solutions to everyday problems.

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RO	Robotics	**AI**	Artificial Intelligence
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STEAMBRACE

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Ages	Difficulty	Curricula associated	Session name	Type	Topics	Areas covered	Description
11-12	Medium	✓	**Give me a hand**	Hands on and connected activity	RO/IN/C		In this session, students will learn about the reality of people with physical disabilities, a global issue affecting around 1.3 billion people. They will explore the progress made through technological advancements to improve accessibility, as well as the ongoing challenges due to limited opportunities, locations, and policies. The activity includes working on a prosthetic prototype using robotics and tools, and also researching the stories of female Paralympic athletes.
11-12	Hard	EXTRA	**The magic of mathematics**	Connected activity	G/IN		The activity focuses on learning about the history of mathematics and highlighting important female mathematicians who, over time, have made significant contributions that remain relevant today. Additionally, students will work on a fun project in Scratch where they will program a mathematical trick that guesses ages using logical operations. The aim is to show that mathematics is not just formulas and calculations, but also creativity and wonder.

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RO	Robotics	**AI**	Artificial Intelligence
G	Games	**E**	Experimentation
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STEAMBRACE

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Ages	Difficulty	Curricula associated	Session name	Type	Topics	Areas covered	Description
11-12	Easy	EXTRA	**Building earthquakes**	Hands on activity	C		How do earthquakes affect buildings? Students will work in groups to design and build models of sturdy buildings using various materials. Using the Arduino Science Journal app, they will measure the oscillation of their structures and apply solutions to reduce the effects of earthquakes, gaining hands-on experience in engineering and physics.
11-12	Easy	✓	**Art history**	Connected activity	IN		This activity introduces Artificial Intelligence (AI) and programming through interactive challenges. Participants will learn how AI works, how it differs from traditional programs, and the importance of clear instructions in programming. Using Scratch and Machine Learning for Kids, they will train an AI model to classify passwords by security level, gaining expertise in digital security and AI applications.

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RO	Robotics	**AI**	Artificial Intelligence
G	Games	**E**	Experimentation
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AR	Augmented reality	**IN**	Information
AV	Audiovisual	**3D**	3D modeling

STEAMBRACE

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Ages	Difficulty	Curricula associated	Session name	Type	Topics	Areas covered	Description
13-14	Hard	EXTRA	**Motorising magnets**	Hands on activity	E		In this activity, we will explore how electricity can be generated using natural factors like magnetism and material conductivity. Students will conduct experiments on magnetic fields and build a simple electric motor. By working in teams, they'll learn about the principles of magnetism and how to apply this knowledge in hands-on experiments. Materials will include magnets, batteries, and wires, allowing students to observe firsthand the fundamentals of electric motors.
13-14	Hard	EXTRA	**That's a lot of energy**	Hands on and connected activity	E/IN		Get ready to build your own anemometer! In this workshop, we will become engineers. First, we will learn about how anemometers work, those devices that measure wind speed. We will use materials like cups and craft sticks to build the structure, and then, with a simple motor, we will make the anemometer harness wind energy to produce a small electric current.

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13-14	Easy	✓	**Schematized**	Connected activity	AI/IN		Have you ever thought about how AI could help you study more effectively and make the most of your study hours? In this activity, you will discover various AI tools that can assist you in gathering reliable and verifiable information, and how to process it to create summaries and outlines for later study. While none of these tools can learn for you, they can save you a lot of time, allowing you to better prepare for your exams. To try our new invention we will apply it on searching information and studying about women in the history of energy.
13-14	Easy	✓	**Rock, paper, scissors**	Hands on and connected activity	C/RO/G		In this activity, students will create and programme a circuit with Cirkids to simulate the traditional game "rock, paper, scissors". Using three LEDs, a light sensor, and a microcontroller, they will learn how to connect and control electronic components. Then, with consumable materials, they will design the structure to make their game even more fun.

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13-14	Easy	✓	**The balance of change**	Hands on and connected activity	C/RO/IN		In this activity, we will investigate women in politics, exploring data about countries governed by women or men. We will understand the challenges and learn about equality. With this data, we will program an interactive scale using mBlock, an intuitive platform that will allow us to see how leadership tilts in different countries.
13-14	Easy	EXTRA	**The voice of history**	Connected activity	AI/IN/AV		In this workshop, we will explore the lives and achievements of female inventors like Marie Curie and Ada Lovelace. Each participant will research an inventor and use BlinkShot, an AI tool, to create an animated short about her contributions. We'll also create a unique soundtrack with Suno. Finally, we will present our animation and music, celebrating these inventors and their lasting impact on science and technology.

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15-16	Medium	✓	**Rosalind Franklin: Beyond DNA**	Connected activity	IN/3D		This project encourages students to learn about Rosalind Franklin's life and work, highlighting her achievements in obtaining DNA photographs that helped reveal its structure. Students will create a 3D DNA model, completing a secondary strand based on a primary one, exploring species differences, and examining genetic mutations. This hands-on activity will deepen their understanding of DNA structure and the important contributions Franklin made to science.
15-16	Easy	✓	**Overcoming obstacles**	Hands on and connected activity	AR/3D		In this activity, students will carry out a detailed analysis of their environment to identify the architectural barriers that limit accessibility for people with disabilities or reduced mobility. The aim is to make them aware of the difficulties that many people face in their daily lives and to propose practical technological solutions. They will design in 3D adaptations for those spaces and then with Merge Cube visualize through their camera if those adaptations are viable.

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15-16	Medium	✓	**Machine vs human**	Connected activity	AI/IN		In this activity, students will use Machine Learning for Kids to train an AI to recognize "Rock, Paper, Scissors" gestures and program the game in Scratch. They will also research traditional games and explore gender equality in professional sports, enhancing their understanding of programming, machine learning, and sports equality.
15-16	Hard	✓	**Safety access control**	Hands on and connected activity	RO/AI/SA		In this workshop, we will become hospital security programmers using mBlock. Together, we will create a system that detects whether a person is wearing a mask and protective glasses to allow them access to the hospital. Using sensor programming and simple logic, we will set up a "virtual guard" that decides who can enter based on security measures. We will simulate different scenarios to see how our program responds, gaining a closer understanding of how control systems work in real life.

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15-16	Easy	EXTRA	**Packaging of the future**	Connected activity	3D/IN		From the marmalade jar to smart packaging with AI. In this session, students will discover the reasons behind the shape, materials and characteristics of packaging. They will learn how new technologies are revolutionising the packaging industry, enabling the creation of adaptive solutions that fit the specific needs of each product and consumer. At the end, students will apply what they have learned to propose and design their own adaptive packaging.
17-18	Medium	EXTRA	**Colouring the universe**	Connected activity	AV		In this activity, students will explore how astronomers process space images by assigning colors to different types of radiation for better visualization. Using tools like GIMP, they will simulate how color combinations affect perception and learn how to replicate the process used for images of galaxies. The activity will also address how people with color deficiencies, like color blindness, perceive these combinations.

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17-18	Hard	✓	**Programming music**	Hands on and connected activity	RO/C		In this activity, participants will learn how a buzzer works by connecting it to a microcontroller and exploring sound generation. They will create a homemade speaker using copper wire and magnets, learning about electromagnetism, vibrations, and the interaction between electric current and magnetic fields. This hands-on experience blends theory and practice, encouraging creativity in electronics.
17-18	Hard	EXTRA	**Your pocket assistant**	Connected activity	AI		In this workshop, participants will develop their own AI chatbot using App Inventor. They will learn how to design the chatbot's appearance and program its responses to make it unique and natural. The activity will guide them through the logic and creativity needed to bring the chatbot to life, introducing them to app programming and digital design.

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17-18	Hard	EXTRA	**Real assistant**	Hands on and connected activity	RO/AI/C		In this activity, participants will build and program their own AI robot assistant. Using simple programming tools, they will teach the robot to listen, speak, and respond to questions, while assembling and decorating it to make it unique. This hands-on experience will help students understand how AI assistants work and give them the opportunity to create their own physical robot.
17-18	Medium	✓	**Weather panel**	Hands on and connected activity	RO/AI/C		In this workshop, students will create an interactive weather panel that displays real-time data for any city. They will learn to program and assemble a circuit connected to the Internet to fetch weather updates. The activity will teach how APIs and programming work to access data, while developing skills in electronics, logic, and design.

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