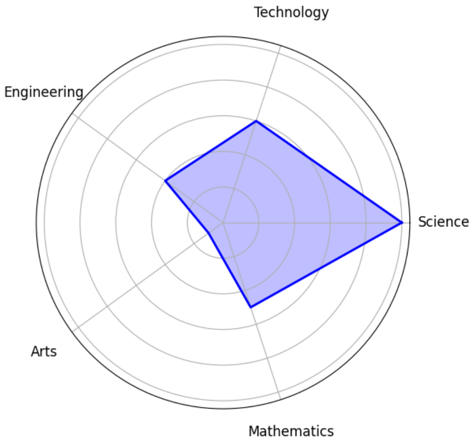
TRAPPED HEAT



	DURATION	1h
	AGE RANGE	11-13
	DIFFICULTY	★☆☆
	TOPICS	SCIENCE EXPERIMENTATION

Description of the project

Have ever explored the greenhouse effect tangibly?

Through a simple experiment, you will generate carbon dioxide and compare it to an environment without CO_2, observing how more heat is retained in the latter. You will not only understand a crucial phenomenon in climate change but will also develop key scientific skills. It is a practical and accessible way to connect science with current environmental issues.

Are you ready to face this challenge?

Objectives: What will I learn?

- Understand the greenhouse effect: Demonstrate how the presence of carbon dioxide in a closed environment can increase heat retention, replicating the greenhouse effect on Earth.
- Apply Scientific Method: Encourage the development of experimental skills by designing, conducting, and analyzing a controlled experiment to compare temperatures under different conditions.
- Become familiar with technology: Use digital tools to accurately measure and record temperature data, integrating technology into scientific learning.
- Develop critical analysis skills.

Materials: What do I need?

Activity Kit:

- Two kitchen thermometers
- Optional: IR lamp + connection cable
- Funnel
- Stopwatch

Provided by the teacher/institution:

- Vinegar
- Baking soda
- Spoons
- Modeling clay
- Measuring jug
- Balloons
- Large container
- 2 identical bottles

Previous preparation

- Prepare the materials before the start of the activity.
- Distribute the participants into groups of 2-3 people.
- Organize the workstations for each group.

RESEARCH

Have a look at these resources

Get ready to dive into an exciting hands-on activity! Before we get started, there are a few key things you might want to learn. You can explore them before the activity or even after you have completed the project—your choice!

Have you ever heard about the greenhouse effect? Can you define it with your words, or maybe by a drawing?

In this activity, we will experiment with two systems to see how each interacts with infrared radiation in two different ways:

- By exposing the systems to sunlight
- By exposing the systems to incandescent or infrared light.

Through these tests, we will explore how different light sources affect the systems and observe how infrared radiation interacts with them.

CREATE

Some things you need before beginning

Watch the following video to find an answer to the previous question

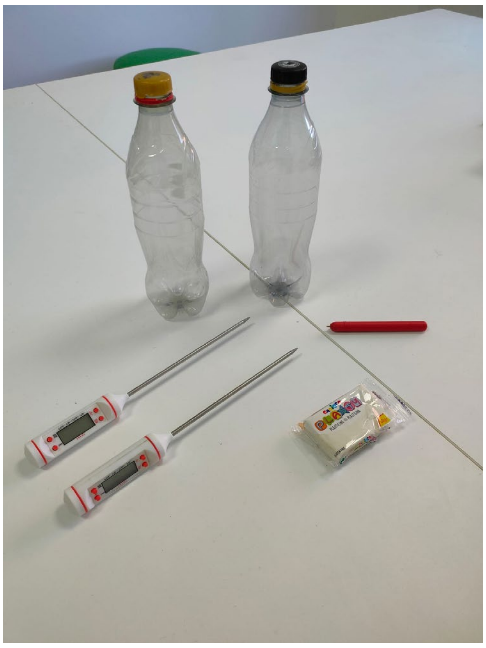
[What Is the Greenhouse Effect?]

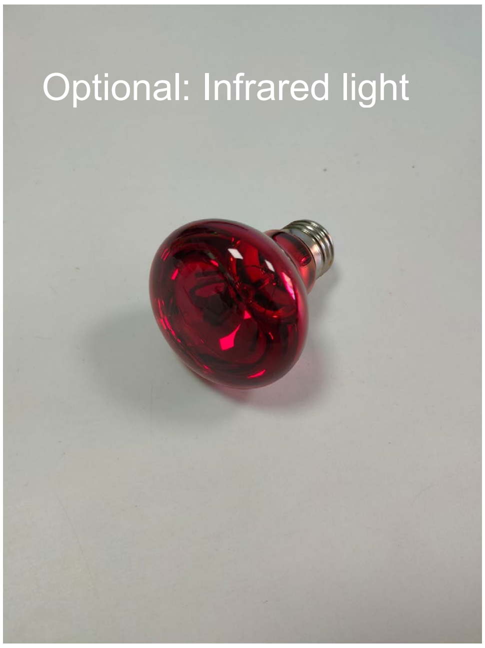
Now let´s explore how different light sources affect the systems and observe how infrared radiation interacts with them!

Now, follow these steps

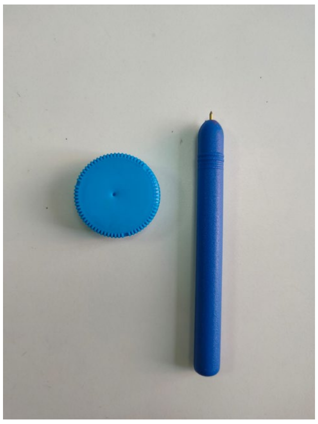
Step 1- Prepare the equipment

Start by gathering all the materials you need for the activity.





Use an awl to make a hole in the center of each bottle cap. Insert a thermometer through each hole and seal the outside of the caps with modeling clay to ensure a tight fit and prevent air from escaping. Do this for both bottle caps.



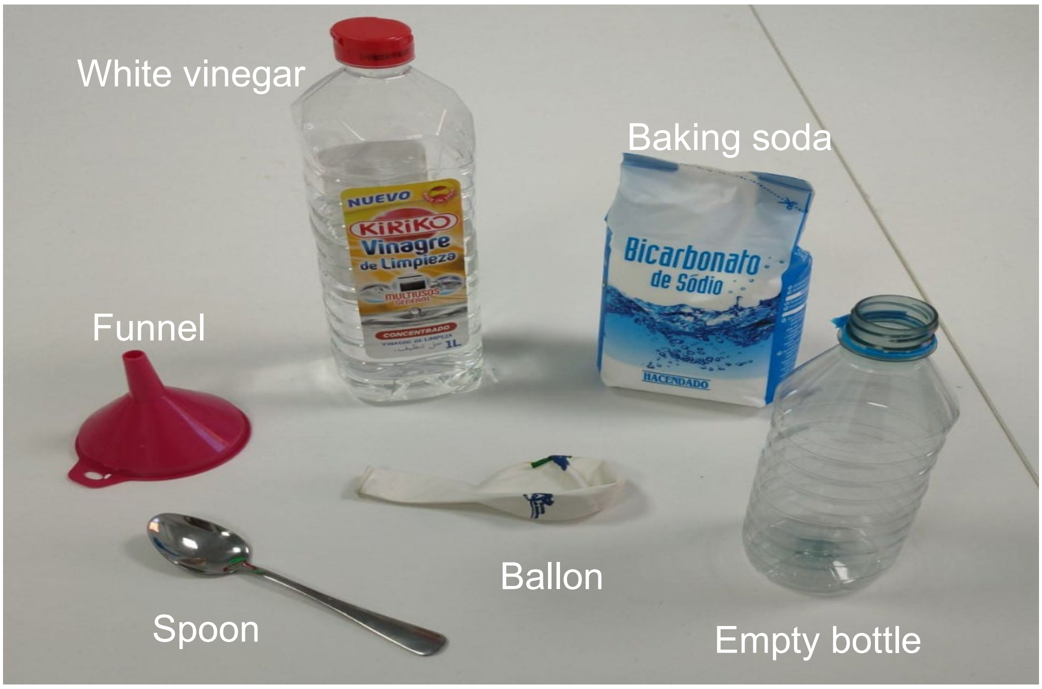
Step 2- Label the Bottles

Use a marker to label one bottle as "CO2" to distinguish it from the other

Step 3- Generate CO2

There are two ways to generate CO2:

1. Blowing into the bottle: You can blow air into the bottle by exhaling, but this will create CO2 at a high initial temperature.
2. Chemical reaction (recommended): To avoid the high initial temperature, you will use a simple reaction: vinegar and baking soda.
   The following elements are needed for the reaction to occur.



- Pour approximately 20 ml of vinegar into the bottle.
- Add about 5 grams (1 tablespoon) of baking soda to the vinegar.
- Wait for the reaction to occur, and the balloon will begin to inflate with CO2.

Step 4- Trap the CO2 in the Balloon

- Once the balloon is fully inflated, pinch the base of the balloon to keep it sealed, preventing the CO2 from escaping.
- Hold the balloon tightly at the opening to prevent gas from escaping while transferring it.
- Place the tip of the balloon at the opening of the bottle labeled “CO2” and quickly seal the bottle to trap the CO2 inside. Make sure the bottle is tightly sealed to prevent any leakage.

Step 5- Prepare the Control Bottle

Prepare an identical bottle, but this time fill it only with air (no CO2).

- Bottle 1: Control (without CO2)
- Bottle 2: Contains CO2

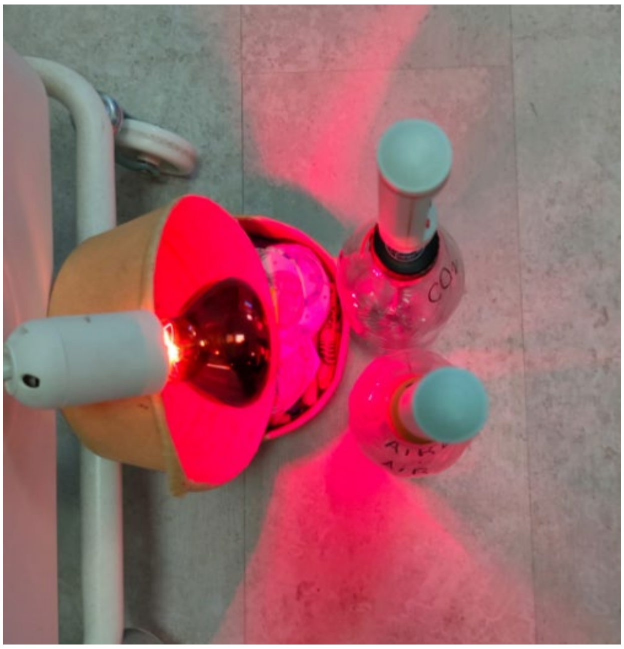
Step 6- Testing with light sources

Using Sunlight:

1. Turn on the thermometers in the classroom and let them stabilize until the temperatures are steady and balanced with the surrounding environment.
2. Place both bottles directly in sunlight and start recording the temperature of each bottle every 1-2 minutes.
3. Record your data in a table (a sample template). gas_temperature_tracker_v0

(Optional) Using an Infrared Light Bulb:

1. Turn on the thermometers in the classroom and let them stabilize as before.
2. Place both bottles directly under the infrared light bulb, ensuring they are at the same distance from the light source.
3. Keep track of the temperatures every 1-2 minutes and record the data in the same table as before. gas_temperature_tracker_v0



Step 7- Observe and compare the results

After collecting the temperature data, compare how the CO2 bottle and the air-only bottle respond to the heat source.

This will help you observe how the gases behave differently when exposed to sunlight or infrared light

Step 8- Annex (a possible solution)

In the last section of this document you will find an experiment that was previously done and the type of behaviour that can be observed from one system compared to another

COMMUNICATE

- **Test the experiment** and compare all the results with each other.
- **Take photos and document the experiment!**

Is time to share!

We invite you to share your results on social media by tagging the STEAMbrace project: #Trapped_heat

- LinkedIn: https://www.linkedin.com/company/steambrace-project?trk=public_post_feed-actor-name
- Instagram: https://www.instagram.com/steambrace_eu/
- X: https://x.com/steambrace_eu

DESING AND KEEP ON LEARNING

Discuss in teams

- Which one heats up more?
- Why do you think this is the case?
- Are the results as expected? Why or why not?
- Does it really heat up more all the time?
- Which one takes longer to cool down?
- Would you make any changes to the experiment? Which ones?
- Do you understand better how greenhouse gases work?

How can I make a similar project by myself?

- **Challenge:** Now create a new prototype on you own, with the materials that you want and test if it works

Which are other connected projects?

Some interesting facts…

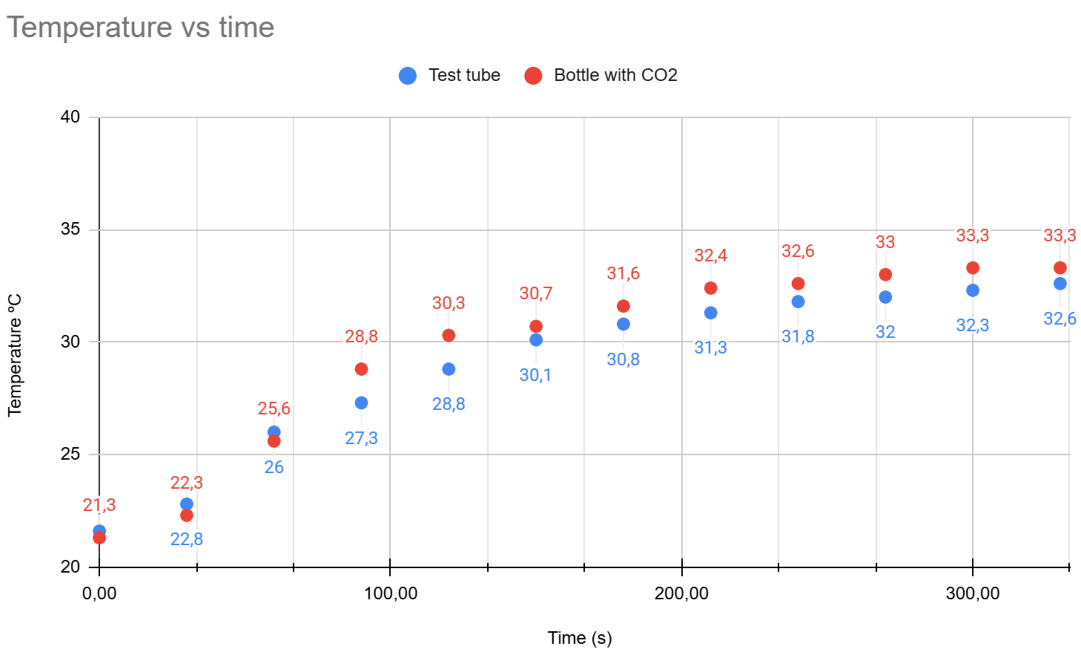
What Is the Greenhouse Effect?

Short video on the subject:_The greenhouse effect is crucial for making Earth a habitable planet. It determines the flow of energy arriving at and leaving Earth. The Sun's energy heats the Earth's surface and the planet radiates energy back into space. However, certain atmospheric gases trap some of the outgoing energy, retaining heat. Without it, the average global temperature would be around -18°C, which would make life as we know it impossible

Step 8- Annex (a possible solution)

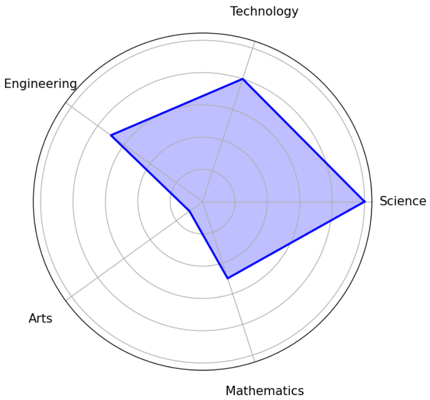
		Control	With CO2
Nº measurement	[t]=seg	[T] = ºC	[T] = ºC
1	0,00	21,6	21,3
2	30,00	22,8	22,3
3	60,00	26	25,6
4	90,00	27,3	28,8

5	120,00	28,8	30,3
6	150,00	30,1	30,7
7	180,00	30,8	31,6
8	210,00	31,3	32,4
9	240,00	31,8	32,6
10	270,00	32	33
11	300,00	32,3	33,3
12	330,00	32,6	33,3



Funded by the European Union

ROCKETS



DURATION	1h
AGE RANGE	11-13
DIFFICULTY	★☆☆
TOPICS	SCIENCE EXPERIMENTATION

Description of the project

Have you heard of ESA? What kind of relationship does your country have with this space agency?

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?

Objectives: What will I learn?

- 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

Materials: What do I need?

Activity Kit:

- 25 ml beaker
- Cylindrical tube that closes hermetically
- Effervescent tablets

Provided by the teacher/institution:

- Camera mobile

- Printed rocket template
- Tape
- Scissors
- Jars with water
- Skewer stick
- Cardboard

Previous preparation:

- Rockets printable
- Creating working groups (2-3 participants /one template per working group)
- Tables prepared to get dirty
- Setting up equipment /devices /materials
- ANNEX: Tutorial: Tracker Video Analysis

RESEARCH

Have a look at these resources

Get ready to dive into an exciting hands-on activity! Before we get started, there are a few key things you might want to learn. You can explore them before the activity or even after you have completed the project—your choice!

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, **you will explore how environmental conditions change when certain elements are absent** or present in very small amounts. You will **design and build your own rockets**, then test them by controlling different variables to see how these adjustments impact their efficiency.

This hands-on activity will help you understand how environmental factors affect performance and allow you to optimize your rocket designs**.**

Let's combine creativity and science, to optimize your rocket designs!

CREATE

Some things you need before beginning

Watch the video- "Why Earth is a prison and how to escape it".

Watch this video on how we can 'break' the gravitational pull of the earth so that rockets can go into space.

[Why Earth Is A Prison and How To Escape Itç]

We are going to use the same idea of using energy to make something 'go up' in a chemical reaction to give us the energy we need to work on our rockets.

And when it comes to putting rockets into orbit...*What things do you think are important when sending something into space?*

Consider different issues:

- Fuel
- Weight
- Launch location
- *Can you think of anything else?*

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?

Now, follow these steps

Step 1- Form Groups

Divide the participants into groups of 3-4 students.

It is best to work in an open space for this activity.

Step 2- Distribute Rocket Kits

Each group will receive 1 rocket kit to build their rocket and conduct their experiment.

Step 3- Assign Control Experiment

The instructor will designate one group to conduct the 'control experiment' to set a standard for comparison. This control experiment will follow a tried and tested protocol.

Control Protocol:

- 15 ml of water
- One whole, unground effervescent tablet

Step 4- Perform Initial Launch

The designated group will conduct the 'initial launch,' while the other groups will record data such as:

1. Time it takes for the rocket to take off
2. Height reached (use a reference height, like a column of known height)

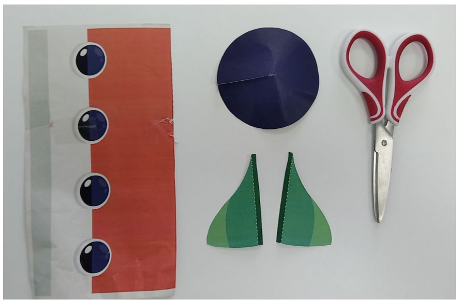
Step 5- Launch Procedure

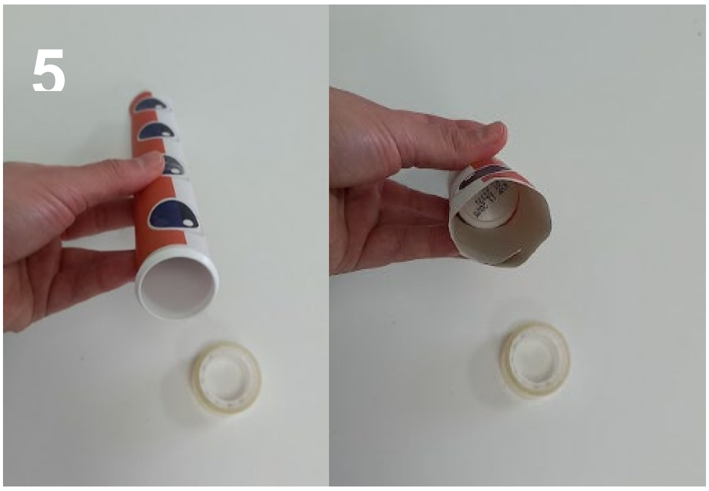
To carry out the model launch:

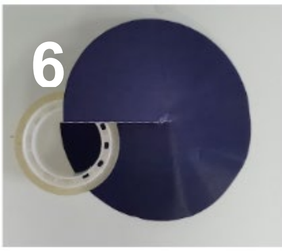
a) Cut out and mount the rocket template on the vitamin tube. Ensure the rocket's tip faces the closed end of the tube to allow the fuel to exit from the back.

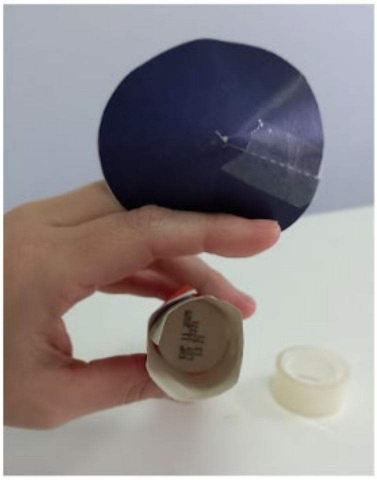
b) Move to an open space or a location where it is okay for things to get messy.

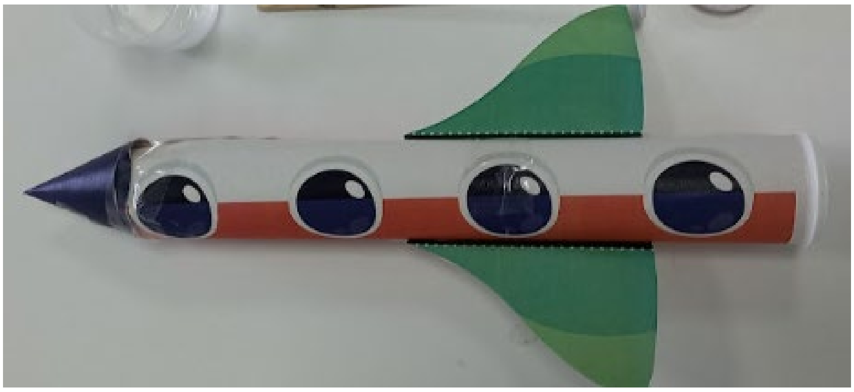

Academia de inventores
¡Crea tu propio cohete para la carrera espacial!




5

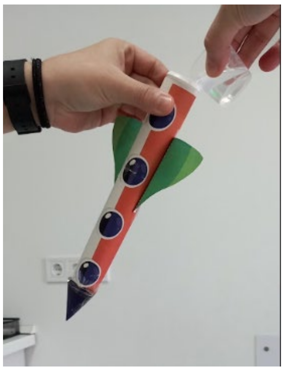

6

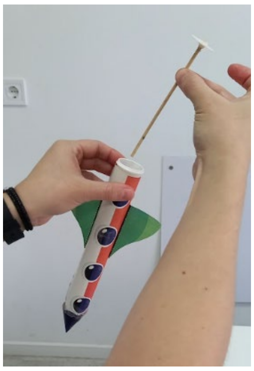


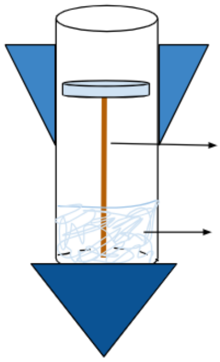


c) Pour 15 ml of water into the beaker and then into the vitamin tube. Be careful not to let the water touch the walls as it falls into the tube for optimal results.

d) Give each group a wooden rod (like a skewer stick). The students will create a disc of smaller diameter than the tube's opening, which will be placed on the end of the rod (this can be made of any material, such as plastic or cardboard).







e) Give each group one effervescent tablet and instruct them to place it on the disc. **Important: Make sure the rocket is not tilted**, as the water or disc should not get wet before the reaction starts.

f) The rocket is then covered (with the open side facing upward), ensuring it remains vertical and that no water touches the walls. It may take a little force to tightly seal the lid, as the wooden stick and disc may touch the bottom of the lid.

g) Once the rocket is sealed, students quickly turn the rocket upside down and place it on the table. After about 30 seconds, the rocket will take off.

h) After launch, ask the students to collect the rockets, rods, and caps and place them in a designated basket for used materials.

Step 6- Modify Variables and Test

The other groups will now modify one variable per group to see if they can improve the rocket's performance (higher flight, quicker launch, etc.). Some ideas include:

- Group 1: Change the amount of liquid
- Group 2: Change the type of liquid
- Group 3: Grind the effervescent tablet
- Group 4: Make the rocket tip more pointed

Each group will test their modified experiment and **compare their results** with the control group's data**.**

The challenge is to discover which adjustments make the rocket perform better, whether it is flying higher, taking off faster, or achieving a more impressive launch!

Step 7- OPTIONAL –
Extended Activity: Data Analysis and Comparison

If you want to dive deeper into the experiment, you can extend the activity by recording your rocket launches with your mobile phone from a distance. Use a reference measurement (like a known height) to capture the launches. Afterward, you will analyze the data using the **Tracker** app.

You will compare your "naked eye" observations with the data to see if they match. **Create graphs** from the Tracker app and check the maximum height each rocket reached. This will give you a better understanding of how your modifications affected the rocket's performance! [Tutorial: Tracker Video Analysis]

COMMUNICATE

- **Test the models** created by others and compare all the results with each other.
- **Discuss** which worked better, which worked worse, why you think this is the case and what you would do to improve it.

Is time to share!

We invite you to share your results on social media by tagging the STEAMbrace project: #Rockets

- LinkedIn: https://www.linkedin.com/company/steambrace-project?trk=public_post_feed-actor-name
- Instagram: https://www.instagram.com/steambrace_eu/
- X: https://x.com/steambrace_eu

DESING AND KEEP ON LEARNING

Discuss in teams

1. What have you learned?
2. How did you learn it?
3. What was the easiest/hardest for you?

How can I make a similar project by myself?

- Would you be able to create another project using your own ideas?
- **Challenge:** Now create a new prototype on you own, with the materials that you want and test if it works

Which are other connected projects?

Some interesting facts…

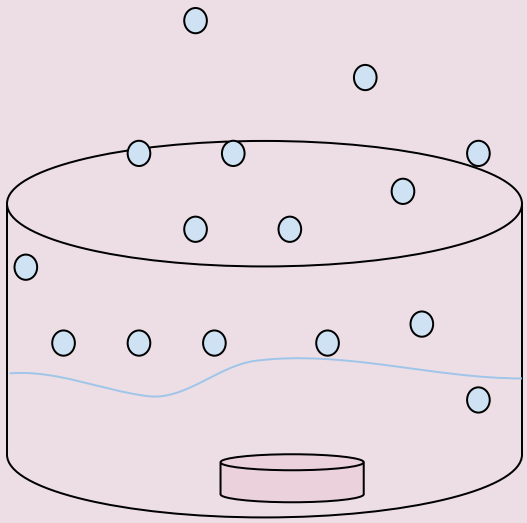
Note

Chemical explanation of the experiment:

Has anyone ever taken a medicine for a tummy ache that when you put it in water, bubbles come out?

Essentially, we did that in this experience: we used an effervescent pill to make our rocket fuel work. But why does it fly? Here we can let the children answer why for a little bit and then we can give an explanation.

What do the effervescent tablets release when you put them in water? Bubbles. And what do those bubbles have in them? When you blow a bubble blower and make a big bubble inside it, it has air in it, right? So far so good. But most of the effervescent tablets release carbon dioxide (CO_2) which in the end mixes with the air in the environment. However, when we put one of these tablets in a glass, it doesn't fly away; why? In the case of the glass, it is open at the top, so the CO_2 inside the bubbles that are constantly forming and bursting is released directly into the environment (what you see are CO_2 molecules, not bubbles):



On the other hand, for our rocket, as it is covered (not open), all those CO2 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.

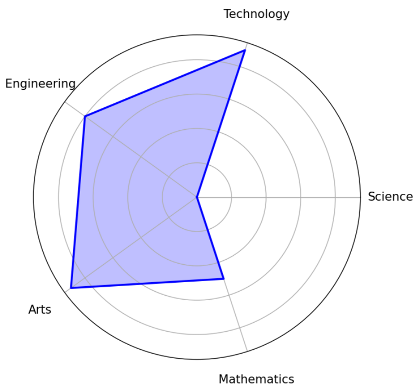
Why do you think we use the stick with the disc? We can leave some space for the children to answer what they think, and in general, they tend to answer correctly. The stick with the disc is so that when you put the tablet inside the disc, the reaction DOES NOT HAPPEN, because the tablet is isolated 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)

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.

HACKING STREET FURNITURE



	DURATION	1h
	AGE RANGE	11-13
	DIFFICULTY	★☆☆
	TOPICS	3D CREATIVITY DESIGNING

Description of the project

Have you ever thought about improving city´s street furniture?

In this activity you will start by analysing public litter bins to identify where they can be made more functional and sustainable.

Use the Tinkercad platform and your paper prototypes to create and test your own redesign ideas.

In this activity, by using technology, you will have to use your creativity and critical thinking to find practical solutions to everyday problems.

Objectives: What will I learn?

- **Learn to critically analyse** everyday objects to identify problems and generate practical solutions.
- **Become familiar with technology:** use 3D design tools.
- **Develop basic 3D design skills**: using the Tinkercad platform.
- **Learn physical prototyping techniques:** use paper to turn their digital designs into physical models.

Materials: What do I need?

Provided by the institution:

- Computers with internet connection
- Paper
- Marker pens/pencils

Previous preparation:

- To access Tinkercad you need to have a login account. (https://www.tinkercad.com/)

RESEARCH

Have a look at these resources

Get ready to dive into an exciting hands-on activity! Before we get started, there are a few key things you might want to learn.

Imagine a city where everyone—regardless of ability or situation—can move freely, enjoy public spaces, and feel included.

Cities are meant to make life easier for everyone, but for many, they create challenges instead of opportunities. People with disabilities, older adults, parents with strollers, and those with temporary injuries often struggle with mobility, understanding signs, or navigating spaces that are not inclusive.

By making cities accessible to all, we improve life for these groups and build stronger, fairer, and more united communities. Together, we can create spaces where everyone can thrive and achieve their goals

Get Inspired: Reflect & Discuss

Before diving into hands-on activities, let's spark our creativity by reflecting on how cities can become more inclusive. Join the discussion to share ideas and explore possibilities. Here are some questions to guide our conversation:

- **What works well?** Can you think of modifications in your city that successfully support people with disabilities?
- **What are the barriers?** What obstacles do individuals with disabilities encounter daily in your community?
- **Street furniture matters:** How can items like rubbish bins, pavements, playgrounds, or benches be improved to help overcome these barriers?
- **Garbage bins:** Are they accessible to everyone? What changes would make them easier to use?
- **Water fountains:** How could park water fountains be adapted for people with disabilities?
- **Playgrounds:** Are playgrounds in your area accessible to children with motor disabilities? What changes could make them more inclusive?

Hands-On Creativity: Bringing Ideas to Life

After exploring these questions and exchanging ideas, we will dive into the exciting world of design! Using technological tools, like 3D design environments, we will transform our ideas into practical, real-world solutions. Together, we will create concepts that could reshape our cities into spaces where everyone belongs.

Discover a journey to imagine, design, and innovate for a more inclusive future!

CREATE

Some things you need before beginning

Watch the video- "Tinkercad Basics: Get Ready to Design!"

Before diving into the main activity, it's important to familiarize yourself with Tinkercad, a powerful and user-friendly 3D design platform. This foundational step will help you fully engage with the tasks ahead.

Step 1- Explore the Tinkercad Platform

Visit **Tinkercad** and take some time to explore its features.

Step 2- Learn Through Tutorials

To get comfortable with the platform, check out this series of beginner-friendly tutorials: **YouTube Playlist: Tinkercad Tutorials**.

These tutorials will guide you through essential skills, including:

- Joining pieces together
- Rotating objects
- Cutting shapes
- Performing other basic transformations

Step 3- Practice Makes Perfect

Before starting the main activity, ensure you have practiced these basic transformations. Try replicating the examples in the tutorial to build confidence and get the most out of the upcoming design tasks.

This preparation will set you up for success and make the rest of the activity more engaging and enjoyable!

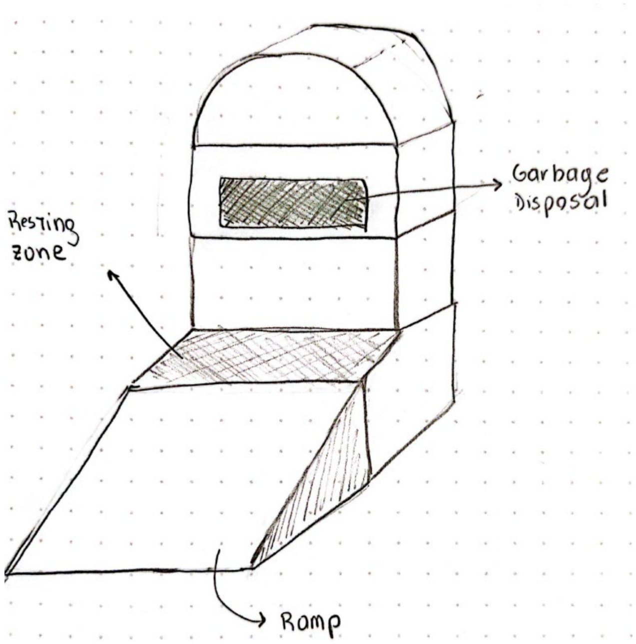
Now, follow these steps

Step 1- Hacking Urban Furniture

Now that you're familiar with Tinkercad, it's time to put your creativity to work by designing solutions for more inclusive urban furniture! In this activity, you will take the ideas discussed earlier and bring them to life using 3D modeling.

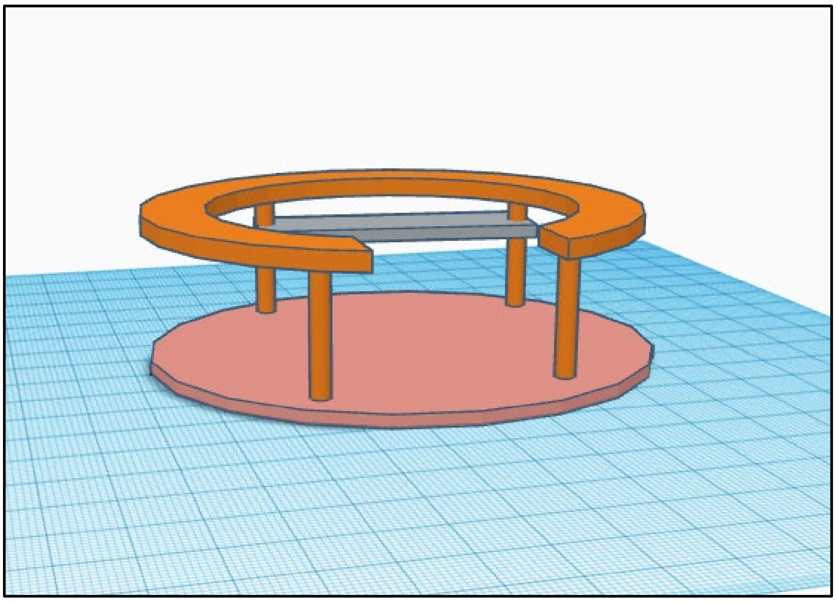
Sketch Your Idea

Before jumping into 3D modeling, create a simple pencil-and-paper sketch of your idea. This step helps you visualize and refine your concept before translating it into a digital design. Below are examples of potential ideas to inspire you, but feel free to come up with your own unique designs!



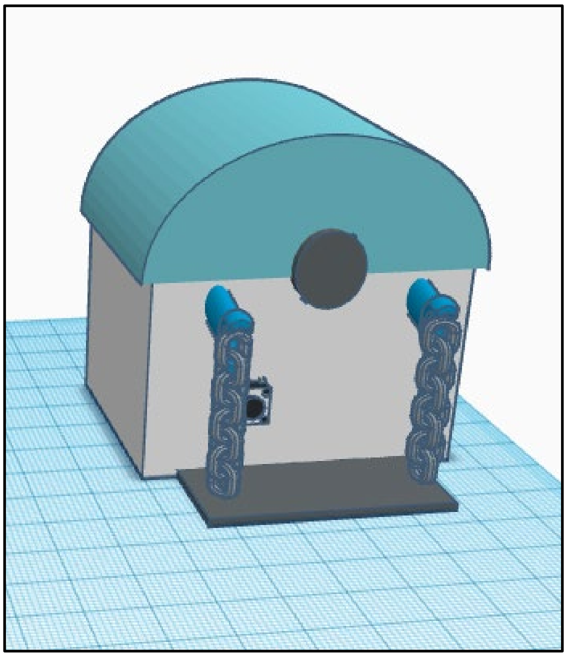
Example 1: Accessible Recreational Area for Children in Wheelchairs

- Many playgrounds have spinning swings, but they often lack space for children using wheelchairs.
- This design includes a secure area for wheelchair access, allowing all children to enjoy the playground.



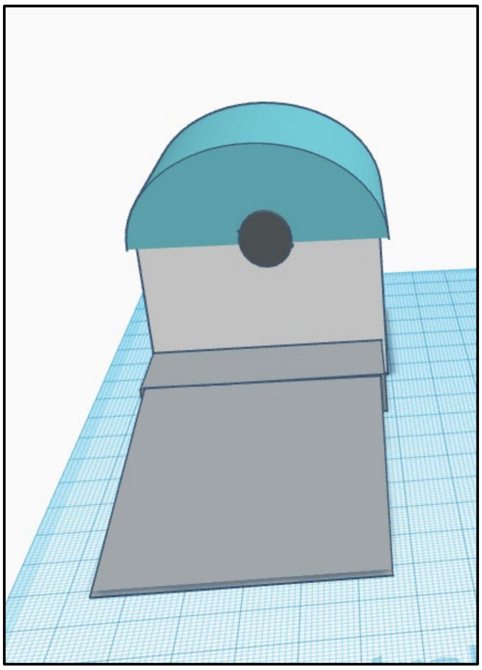
Example 2: Dumpster with a Lifting Platform

- In many areas, garbage containers have openings that are too high to reach.
- This design features a lifting platform activated by a button, making it easier for everyone to use.



Example 3: Accessible Garbage Container for Low-Resource Areas

- High-tech solutions may be too expensive for municipalities with limited budgets.
- This concept includes a ramp to provide easier access to garbage containers at a lower cost.



Step 2- Bring Your Design to Life in Tinkercad

Once your sketch is ready, log into Tinkercad and start building your idea in 3D. Use the tools and skills you learned during the tutorials to bring your concept to life.

Experiment, iterate, and create a model that showcases your vision for more inclusive urban furniture**.**

TIP: "Tinkercad gallery".

If you are in need of some inspiration you may enter the Tinkercad gallery: https://www.tinkercad.com/things and search there for some street furniture or other stuff that may inspire you.

COMMUNICATE

- **Present your design to your peers** share the challenges you addressed and the innovative features you have included.
- **Discuss** and explain how their proposals improve the accessibility and functionality of the objects they redesigned.

Is time to share!

We invite you to share your results on social media by tagging the STEAMbrace project:

#Hacking_street_furniture

- LinkedIn: https://www.linkedin.com/company/steambrace-project?trk=public_post_feed-actor-name
- Instagram: https://www.instagram.com/steambrace_eu/
- X: https://x.com/steambrace_eu

DESING AND KEEP ON LEARNING

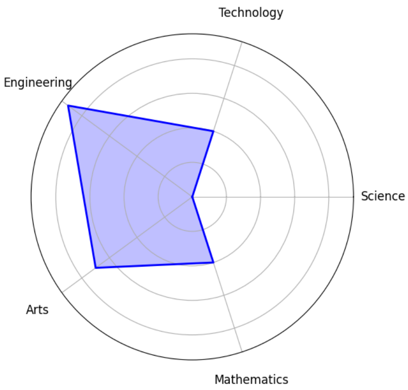
Discuss in teams

1. What have you learned?
2. How did you learn it?
3. What was the easiest/hardest for you?

How can I make a similar project by myself?

- Would you be able to create another project using your own ideas?
- Challenge: Now create a new prototype on you own.

BUILDING EARTHQUAKES



DURATION	1h
AGE RANGE	11-13
DIFFICULTY	★☆☆
TOPICS	CRAFTS

Description of the project

How do earthquakes affect buildings?

We will work in groups to design and build models of resistant buildings using a variety of materials. Using the Arduino Science Journal app, we will measure the oscillation of their structures and apply solutions to reduce the effects of earthquakes, gaining hands-on experience in engineering and physics.

Objectives: What will I learn?

- Understand seismic phenomena, their origin in the movement of tectonic plates and how they affect structures.
- Learn about the principles of earthquake-resistant construction, such as damping of oscillations and seismic isolation.
- Encourage creativity and teamwork.
- Develop technological skills using the Arduino Science Journal application to measure and analyse the oscillations of their constructions.

Materials: What do I need?

Provided by the institution:

- Mobile with Arduino science journal installed
- Shoe boxes
- Sheets of cardboard or paper larger than the box
- Marker pens
- Tape
- Rubber bands
- Paper clips or pins

- Cotton
- Straws
- Pipe cleaners
- Thread
- Springs
- Ruler
- Scissors

Previous preparation:
- Ensure that the mobile phones have the Arduino Science Journal app installed and are working properly.
- Prepare the materials

RESEARCH

Have a look at these resources

Get ready to dive into an exciting hands-on activity! Before we get started, there are a few key things you might want to learn. You can explore them before the activity or even after you have completed the project—your choice!

In this session, we will explore earthquakes and earthquake engineering.

Earthquakes happen when tectonic plates beneath the Earth's surface move, causing the ground to shake. These natural events can have a huge impact on the buildings and structures we use every day. Over time, engineers and architects have come up with smart ways to make buildings more resistant to these powerful forces, which brings us to the fascinating world of earthquake-resistant construction.

But we won't just learn about earthquakes**—we'll become engineers ourselves!** In this activity, you will **design and build** models of buildings and experiment with different materials and techniques to see how they can make structures more resistant to earthquake forces.

To test your creations, we will use a cool tool: the **Arduino Science Journal app**. This app will help us measure the vibrations and oscillations of your buildings, giving you real data to see how well your engineering designs stand up to the challenge.

Let's combine creativity, science, and engineering to tackle the power of earthquakes and create something amazing!

CREATE

Some things you need before beginning

Get ready for a hands-on workshop where you will experience the science and creativity behind earthquake-resistant engineering!

In this session, participants will be divided into groups, and each group will receive:

- **A shoebox** representing a building.
- **A base** designed to simulate an earthquake by moving horizontally along one axis.

Here is how it works:

The instructor will demonstrate how a mobile device can measure the oscillation (shaking) of the box on the moving surface. Then, the instructor will show how adding objects like markers or straws beneath the box allows it to roll, reducing the shaking. This happens because the movement between the base and the box is minimized. The demonstration highlights an important engineering principle: the key to reducing earthquake damage is to prevent the building from moving with the ground.

Now it is your turn to innovate!

Each group will be challenged to design a system that helps their "building" (the box) survive the earthquake. But there's a twist: while the markers reduce shaking, they're not a perfect solution because the box can slide off them easily.

You will receive a variety of materials to create your solution, and if you'd like, you can even decorate your shoebox house. **Think outside the box—literally!**

At the end of the workshop, we will test all the designs and see which system performs best under simulated earthquake conditions.

Bring your creativity and problem-solving skills to this engaging activity, and let's see which group can engineer the ultimate earthquake-proof design!

Now, follow these steps

Step 1 – Form Engineering Teams

Kick off the activity by dividing the participants into small groups. Aim for groups of 3–4 members to ensure that everyone can actively participate in brainstorming, designing, and building their structures. Each group will receive:

A shoebox (representing a building).

A base (simulating the ground during an earthquake).

This team setup encourages collaboration and ensures everyone gets hands-on experience with the project.

Step 2 – Understanding Earthquake-Resistant Construction

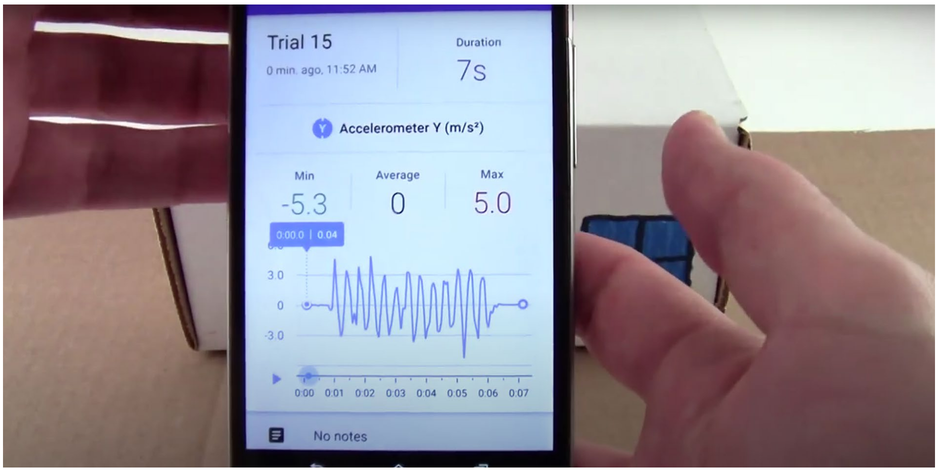
Next, the instructor will demonstrate the impact of earthquakes on buildings and introduce the science behind making structures more resilient.

- **Demonstration** Setup:

Place a shoebox on one of the bases and simulate an earthquake by moving the base horizontally along one axis. Explain how the shaking represents the forces a building experiences during an earthquake.

- **Quantify** the Shaking:

Open the Arduino Science Journal app and start a new experiment. Use the accelerometer tool, focusing on the Y-axis, to measure the side-to-side movement of the box during the simulation.



- **Attach** the Mobile Device:

Stick the mobile device (with the Arduino Science Journal app open) to the shoebox using tape or double-sided tape. This ensures that the device captures the oscillation of the box itself and not any other movement.

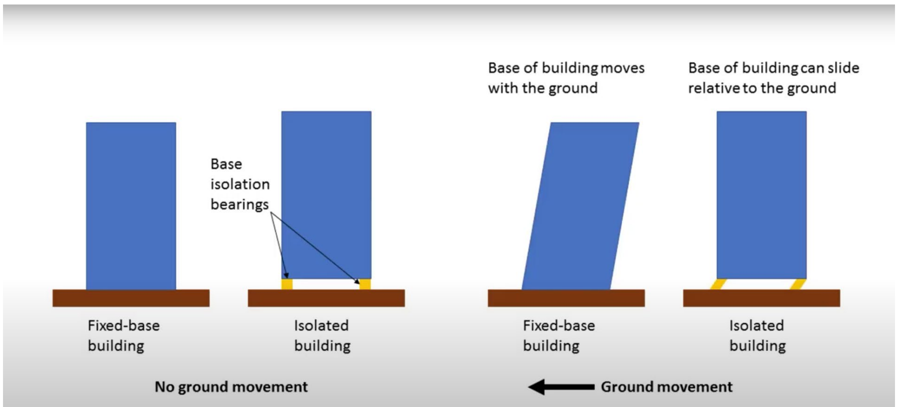
- **Simulate** the Earthquake:

Place the box on top of the base. Move the base forward and backward repeatedly along one axis to simulate the shaking caused by an earthquake.

- **Observe and Record**

Use the app to measure and record the oscillation data on the Y-axis.

To build an earthquake-resistant building, engineers design structures that can withstand the horizontal forces of an earthquake. Since earthquakes release large amounts of energy and load buildings sharply from one direction, an earthquake-resistant structure must also be able to move in the opposite direction.

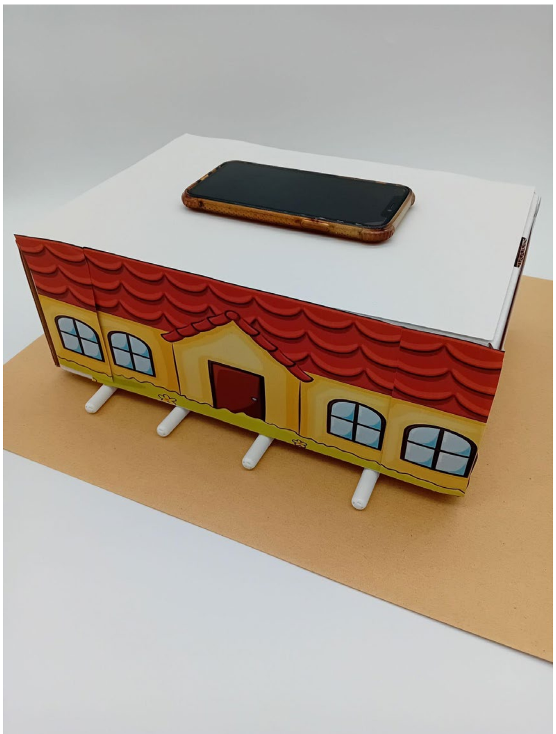


One way of counteracting horizontal seismic forces in the ground is, on the one hand, to place the foundations of a building above the surface level and, on the other hand, to separate them from the subsoil with the help of elastic rubber bases composed of layers of steel, rubber and lead. When the subsoil moves during the earthquake, the anti-seismic supports vibrate next to it and absorb most of the kinetic energy, affecting the building less, in a similar way to the shock absorbers of a car.

- **Test this** with some markers under the box.

Repeat the previous experiment and see that the oscillation is significantly reduced.

This happens because not being rigidly anchored to the ground, the box has to remain at rest according to ***Newton's 1st law: every object at rest will remain so until a force affects it.*** However, this system is not perfect because the house can easily come off its foundations.



Step 3 - Build Earthquake Models

- **Create your own model** using the materials we have here.

The objective is that the house stays static in one area without moving out of the cardboard and oscillate as little as possible.

- **Decorate the boxes** to make sure everyone in the group has tasks to do, but the priority and focus should be on designing a system to prevent an earthquake.
- Below are some examples for inspiration

COMMUNICATE

- **Test the models** created by others and compare all the results with each other.
- **Discuss** which worked better, which worked worse, why you think this is the case and what you would do to improve it.

Is time to share!

We invite you to share your results on social media by tagging the STEAMbrace project: #Building_earthquakes

- LinkedIn: https://www.linkedin.com/company/steambrace-project?trk=public_post_feed-actor-name
- Instagram: https://www.instagram.com/steambrace_eu/
- X: https://x.com/steambrace_eu

DESING AND KEEP ON LEARNING

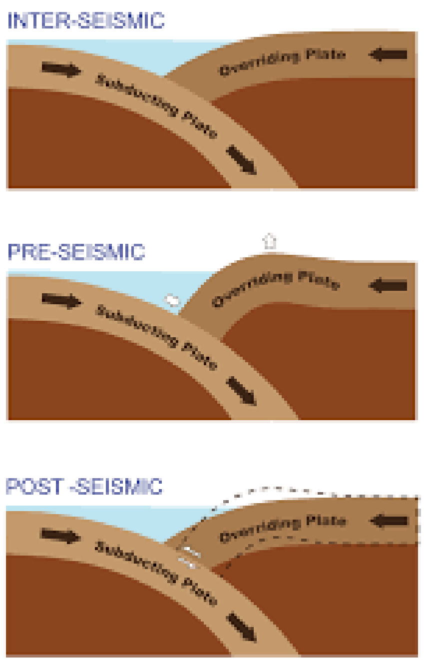
Discuss in teams

1. What are the consequences of earthquakes in large cities?
2. How do they affect infrastructure and people?
3. Do you think that all cities in the world have the same difficulty recovering from a natural disaster?
4. Why or why not?
5. What other prevention and safety measures do you think are important to protect people during an earthquake or other natural disaster?

How can I make a similar project by myself?

- Would you be able to create another project using your own ideas?
- **Challenge:** What is the tallest earthquake proof structure your group can build?

Which are other connected projects?



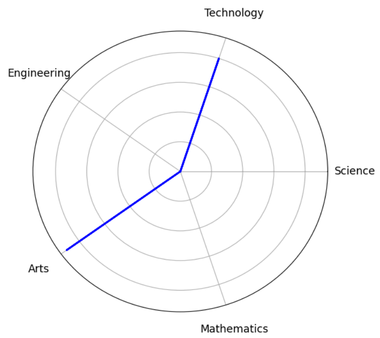
Some interesting facts…

The earthquake phenomenon

Earthquakes are produced by the constant movement between tectonic plates that produce friction and deformations that accumulate enormous amounts of energy. When this energy is released and exceeds the elastic limit of the rocks, it produces a rapid and violent fracture that causes the earthquake.

This can be visualised by bending a ruler: when it is released, it shakes and oscillates. We can imagine what would happen if there were buildings standing on top of it.

ART HISTORY



DURATION	1h
AGE RANGE	11-13
DIFFICULTY	★☆☆
TOPICS	ART AI RESEARCH AUDIOVISUAL

Description of the project

Have you ever researched the life and work of women painters, sculptors, photographers and designers?

Through this activity you will have the chance to explore their careers, their most relevant works and the influence they have had on the development of art, and to get to know and value their legacy in the artistic field.

You will have the chance to work on a **collaborative wall Padlet, designing collaboratively and visually a mural. Finally,** you will obtain a virtual gallery where each contribution will be shown as a part of the female artistic legacy.

Are you ready to face this challenge?

Objectives: What will I learn?

- Recognise the impact of women in art history
- Develop research skills
- Encourage creativity and digital design
- Encourage teamwork

Materials: What do I need?

Provided by the institution:

- Computer with connection

Previous preparation:

- Padlet tutorial
- Google arts & Culture: https://artsandculture.google.com/

RESEARCH

Have a look at these resources

Get ready to dive into an exciting research and creation activity! Before we get started, there are a few key things you might want to learn. You can explore them before the activity or even after you have completed the project—your choice!

Did you know that a woman was the first to paint a self-portrait that is considered a masterpiece of Western painting?

She was **Frida Kahlo.** Her unique style revolutionized the art world, challenging conventions of her time by deeply expressing her personal suffering and identity

What other female artists, whose works have been recognized worldwide, are you familiar with?

As well as Frida Kahlo there are other female artists whose works have been recognised worldwide as conveying a message through their vibrant colours. To name just a few: Georgia O'Keeffe, Yayoi Kusama, Artemisia Gentileschi…

Carry out a little research and find the artists and their works and then include some ideas from their biogarphy On the website **Google Arts & Culture:** https://artsandculture.google.com/, we can explore countless artists, learn about their works and get to know some relevant facts about their biographies.

Choose 3 or 4 artists and write down curious facts about their life and work. In addition, they will compile the names of their most relevant works in order to include them on their digital wall.

Compile the names of the artists and their most relevant works in order to include them on your digital wall!

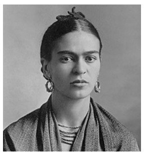
CREATE

Some things you need before beginning

Initial activity

Let's see how much you know about the art world.

Connect with arrows the corresponding artist with her work; first, with the general knowledge and culture that we have on this subject; and then, after researching about each one on the following website**:** https://artsandculture.google.com/







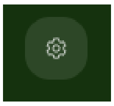

Initial activity SOLUTION, in the annex section.

Now, follow these steps

Your turn! Create the Portfolio in Padlet

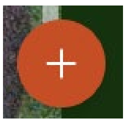
Step 1- Choose a Background

Begin by selecting a background for your portfolio. Go to the settings section on the right-hand side of the screen. You can choose from various default backgrounds or upload your own. For a custom background, you can use https://www.blinkshot.io/, an AI-powered tool that generates instant images.

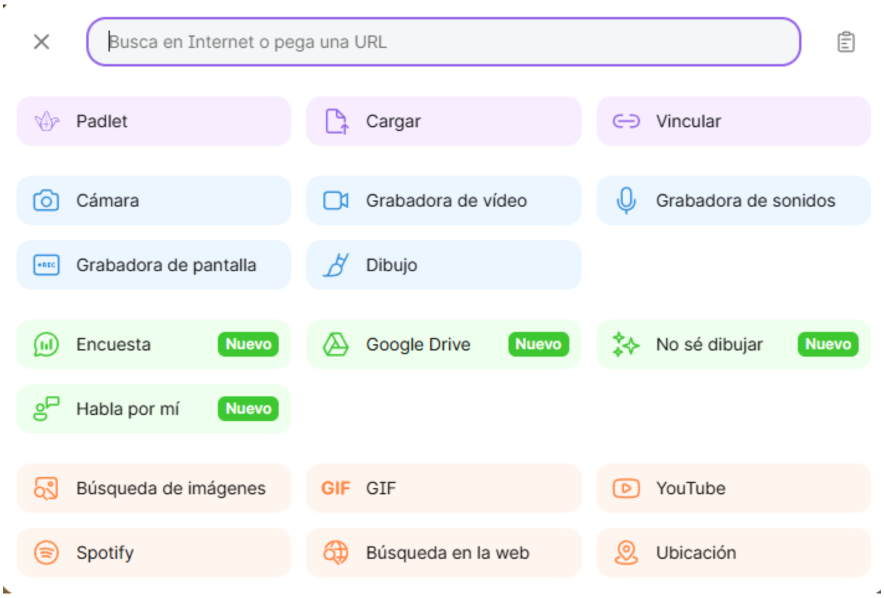


Step 2- Add Entries to Your Digital Wall

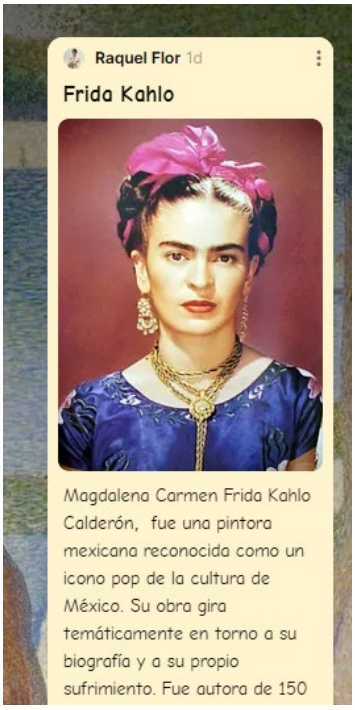
To start adding content, click the symbol in the bottom right-hand corner of the screen or double-click anywhere on the wall.



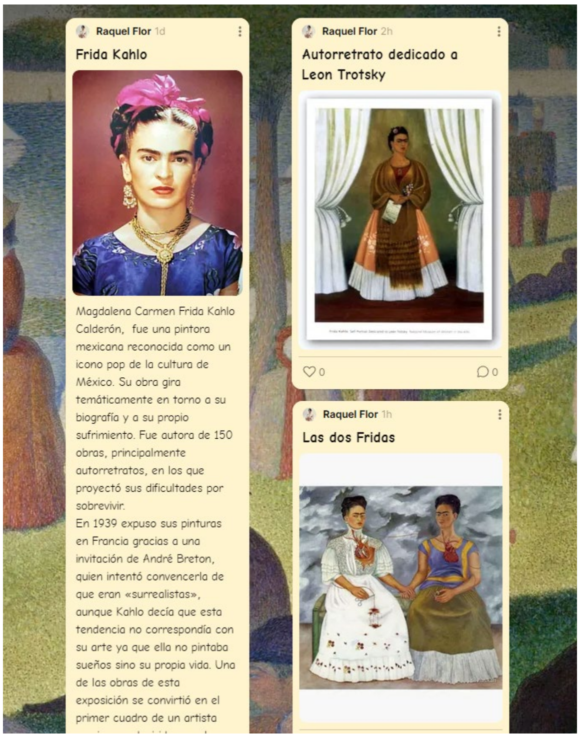
A window will open, allowing you to add different resources like images, links, YouTube videos, or drawings. If you need to create a drawing, use “I don't know how to draw,” an AI tool that can generate portraits of the artists you research.



Step 3- Create Artist Posts:
For each artist you research, create a post with a portrait and a brief biography. You can personalize each post by adding colour to represent each artist's work. To do this, click the three dots in the top right corner of the post and choose a colour.



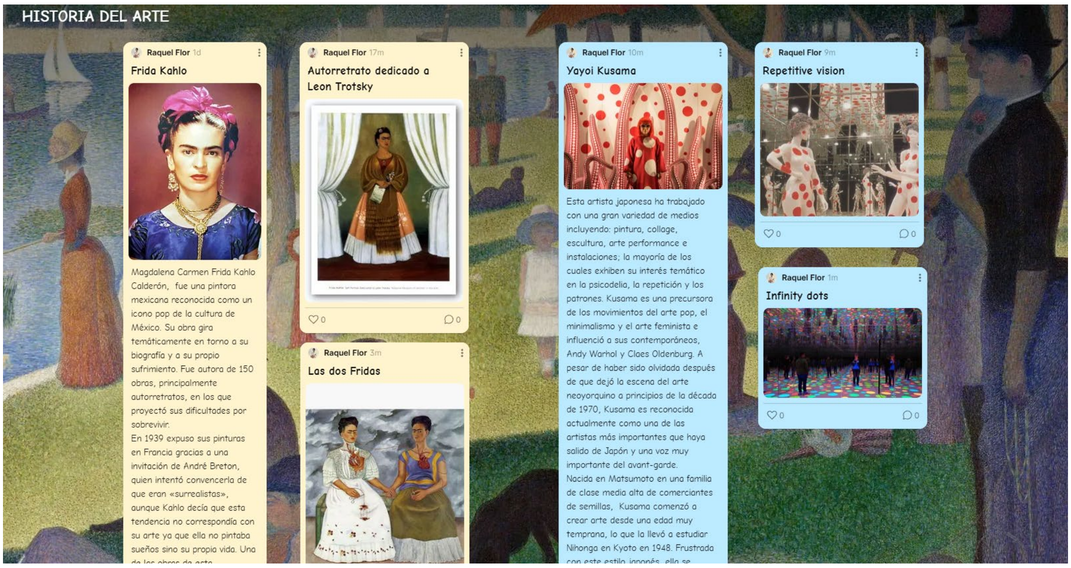
Step 4- Organize the Mural
Surround each artist's entry with posts showcasing their most famous works, arranging them to create a mural-like display of their art.



Step 5- Make it Accessible

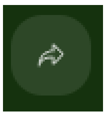
You can include voice recordings in your posts, reading the text aloud to make your portfolio inclusive for visually impaired individuals.

An example of a padlet



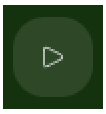
Step 6- Share it!

Once you have completed your portfolio, you can share it with your colleagues and comment on the entries you like best.



You can do this via a link or even a QR code.

You can also share it as a slide show.



COMMUNICATE

- **Present the mural you have made.**
- **Discuss** which artist has most caught your attention, explaining the reasons.

Is time to share!

We invite you to share your results on social media by tagging the STEAMbrace project: #Art_history

- LinkedIn: https://www.linkedin.com/company/steambrace-project?trk=public_post_feed-actor-name
- Instagram: https://www.instagram.com/steambrace_eu/
- X: https://x.com/steambrace_eu

DESING AND KEEP ON LEARNING

Discuss in teams

1. Why do you think some women artists were historically less recognised than their male counterparts?
2. How has the representation of women in the art world changed over the centuries?
3. What role does art play in social change and how do you think these artists contributed to it?
4. You can do a little **research** to compare the situation of women artists in the past with today. Have conditions improved? What challenges remain?

How can I make a similar project by myself?

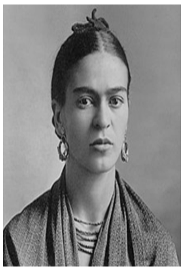
- Would you be able to create another project using your own ideas?
- **Challenge:** Now create a new portfolio to include in another padlet based on your interests, choose a new field for research, another area…

Which are other connected projects?

Some interesting facts…

Anex: Solution of the initial activity

STEAMBRACE
Funded by the European Union
Universidad del País Vasco / Euskal Herriko Unibertsitatea
BILBOKO HEZKUNTZA FAKULTATEA
FACULTAD DE EDUCACIÓN DE BILBAO
Academia de inventores

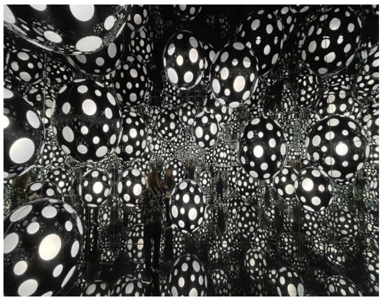


Frida

Yavoi

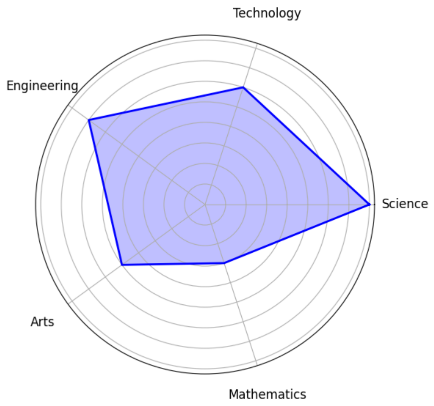
Artemisia

Helen



Funded by the European Union

CONTROL THE SOIL MOISTURE OF YOUR PLANTS!



DURATION	1 hr
AGE RANGE	13-14
DIFFICULTY	★☆☆
TOPICS	SCIENCE PROGRAMMING

Description of the project

This project involves building a simple and effective soil moisture monitoring system to help you care for your plants. By using a **micro:bit**, some basic materials, and a bit of coding, you can create a device that checks the moisture level of the soil in your plant's pot and alerts you when it needs water.

The system works by detecting soil moisture levels using nails as probes. These probes are connected to the micro:bit with alligator clips, creating a simple circuit. The micro:bit reads the electrical conductivity of the soil (which varies with moisture) and displays the results on its LED screen.

This is an excellent project for learning about basic electronics, coding, and plant care, all while exploring real-world applications of technology!

Objectives: What will I learn?

- Understand the relationship between soil moisture, conductivity, and plant health.
- Utilize micro:bit to design and program a soil moisture monitoring system.
- Assemble and optimize a functional circuit for energy-efficient operation.
- Analyze sensor data to interpret soil conditions and calibrate readings effectively.

Materials: What do I need?

- 1 micro:bit with battery pack
- 1 battery for the micro:bit
- 2 long silver nails
- 2 alligator clips

- 1 flowerpot

RESEARCH

Have a look at these resources

Soil moisture is essential for the growth and health of plants. Water in the soil allows roots to absorb the nutrients necessary for photosynthesis and other vital processes. Proper moisture levels also help maintain soil structure, preventing water stress in plants.

When the soil is too dry, plants cannot absorb water or nutrients, leading to dehydration and deterioration. On the other hand, excessive water can suffocate roots, preventing proper oxygenation and causing fungal diseases. This is why monitoring and maintaining the right moisture level in the soil is crucial.

Soil has a certain electrical resistance that varies depending on its water content. This resistance is lower in moist soil because water combined with nutrients facilitates electrical conductivity. In dry soil, the resistance is higher. This principle will be the foundation for measuring soil moisture in this project.

Understanding how moisture affects plants will not only help you care for them better but also equip you with practical skills to apply this knowledge in an efficient monitoring system. Get ready to combine science and technology to benefit your plants!

CREATE

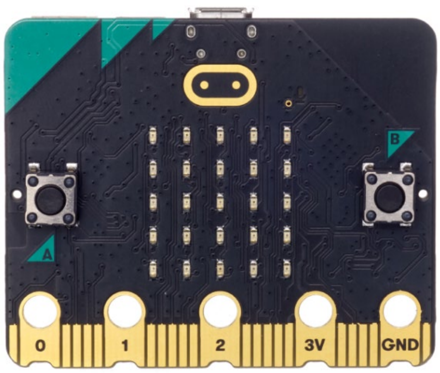
Some things you need before beginning

This is an image of the **micro:bit board**, a compact microcontroller designed for educational and creative projects. Here is an explanation of its key visible components:

1. **Buttons A and B (left and right):**
   - The two physical buttons on the front (labeled A and B) act as programmable inputs for interacting with the micro:bit. They can be used to trigger actions or respond to commands.
2. **LED Matrix (center):**
   - A 5x5 LED grid that can display text, basic graphics, or numeric values. It provides a simple way to give visual feedback in projects.
3. **Input/Output Pin Connector (bottom):**
   - At the bottom, there are several gold contacts numbered as follows:
     - **0, 1, 2:** Programmable pins for connecting sensors, actuators, or external devices.
     - **3V and GND:** Provide voltage (3V) and ground (GND) to power additional components.
   - These pins can also be connected to other devices using alligator clips or jumper wires.
4. **Micro USB Port (top):**
   - Used for uploading programs from a computer to the micro:bit and for powering it during use.
5. **Battery Connector (top center):**

- A connector designed to attach a battery pack, allowing the micro:bit to function autonomously without being connected to a USB port.

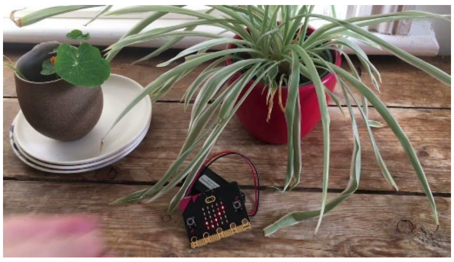
The micro:bit board combines ease of use with the capability to support programming, robotics, and monitoring projects, making it ideal for students and beginners in electronics and computing.



Now, follow these steps

1. **Circuit Connection:**

- Attach a nail to the 3V pin of the micro:bit using an alligator clip, then insert the nail into the soil.
- Attach another nail to the P0 pin of the micro:bit using a separate alligator clip, and insert this nail into the soil as well.



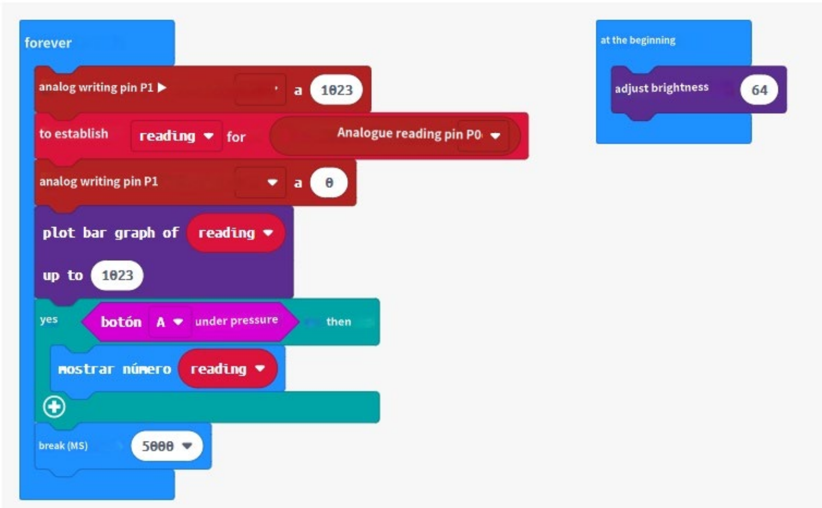
2. **Code Configuration:**

- To calibrate the moisture meter, use a pot with both dry and moist soil.
    - This will allow the micro:bit to recognise dry and moist soil conditions.
    - Water in the soil, combined with nutrients, improves its electrical conductivity. The higher the water and nutrient content, the lower the soil's electrical resistance.

3. **Moisture Measurement:**

- The micro:bit measures moisture by reading the voltage on pin P0. This voltage corresponds to a value that ranges from "no current" (when the soil is very dry) to "maximum current" (when the soil is moist).
- These values are graphically displayed on the micro:bit's LED screen, providing a simple visualisation of the soil's moisture level.
    - Insert the nails into dry soil, and most of the LEDs should turn off.
    - Insert the nails into moist soil, and most of the LED indicators should light up.

- In the previous program, we only have an approximate idea of the sensor value. To improve this, we'll add code to display the current reading when button A is pressed.
  - This code should be placed inside the **forever** loop. Additionally, we will add a variable called reading to store the sensor value.
- Insert the nails into dry soil, press button A, and note the value. You should see a value close to **250** for dry soil.
- Insert the nails into moist soil, press button A, and note the value. You should see a value close to **1000** for moist soil.



COMMUNICATE

Is time to share!

We invite you to share your results on social media by tagging the STEAMbrace project:

Control_the_Moisture

- LinkedIn: https://www.linkedin.com/company/steambrace-project?trk=public_post_feed-actor-name
- Instagram: https://www.instagram.com/steambrace_eu/
- X: https://x.com/steambrace_eu

DESING AND KEEP ON LEARNING

How can I make a similar project by myself?

Take your project to the next level by experimenting with different materials and testing how they affect conductivity measurements. Instead of nails, try using other conductive materials such as copper wires, aluminum foil, graphite rods, or even stainless steel. Observe if these materials offer different levels of sensitivity or accuracy in detecting moisture.

Additionally, adapt your setup to measure the conductivity of water instead of soil. Here's how:

1. Replace the soil with a container of water and submerge your chosen conductive materials.
2. Test water samples with varying compositions, such as distilled water, tap water, and saltwater, to explore how conductivity changes with purity and mineral content.
3. Record and compare the readings to evaluate the performance of different materials and water types.

This experiment expands the scope of the original project and deepens your understanding of conductivity. It also offers insights into how environmental factors, material properties, and liquid compositions influence sensor behavior. This is an excellent way to integrate scientific inquiry with hands-on learning!

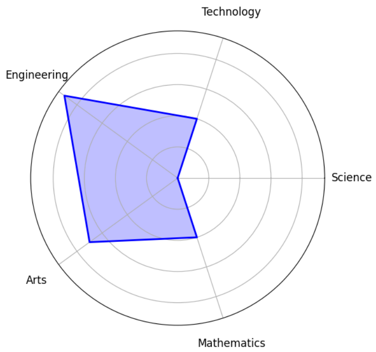
Which are other connected projects?

You can create an automated plant watering system that ensures your plants receive the right amount of water without constant supervision. Using simple materials like a micro:bit, a water pump, and a soil moisture sensor, you can design a smart system that detects when the soil is dry and waters your plants as needed. Check it out!

- Project: https://makecode.microbit.org/v0/projects/plant-watering

STEAMBRACE
Funded by the European Union
Universidad del País Vasco Euskal Herriko Unibertsitatea
BILBOKO HEZKUNTZA FAKULTATEA
FACULTAD DE EDUCACIÓN DE BILBAO
Academia de inventores

THE VOICE OF HISTORY



DURATION	1 hr
AGE RANGE	13-14
DIFFICULTY	★★☆
TOPICS	AUDIOVISUAL IA INFORMATION

Description of the project

In this workshop, we will explore the lives and achievements of women inventors like Marie Curie and Ada Lovelace, learning how their discoveries transformed science, mathematics, and technology. Participants will research an inventor, their contributions, and their impact, using this as inspiration for a project script.

We will bring these stories to life by creating animated shorts using BlinkShot, an AI tool, and enhance them with unique soundtracks created with Suno. Finally, we will showcase our animations and music, celebrating these inventors and their lasting influence on science and technology.

Objectives: What will I learn?

- Enhance research abilities through focused exploration.
- Promote the responsible and ethical use of technology.
- Strengthen communication and presentation skills.
- Encourage critical analysis of historical gender roles and their impact.

Materials: What do I need?

Provided by the teacher/institution:

- Computers with internet connection
- TV or projector.

RESEARCH

Have a look at these resources

Notes
Throughout history, many women have made significant contributions to science and technology, often overcoming social and cultural barriers that limited their opportunities. Despite being overlooked and marginalized, they persevered and left a lasting impact.

- **Hedy Lamarr** invented a telecommunications system that laid the groundwork for modern wireless technology.
- **Katharine Burr Blodgett** created anti-reflective coating, now used in camera lenses, computer screens, sunglasses, and more.
- **Ada Lovelace** developed the first computer algorithm, becoming the first computer programmer in the 19th century.
- **Marie Curie** was the first woman to win a Nobel Prize for her research on radiation, discovering radium and plutonium.
- **Ángela Ruiz Robles** invented the first mechanical encyclopedia, a precursor to e-books.
- 10 Great Inventions by Women: https://youtu.be/IxoHuQNBwFU?si=7JkvjU1Ipvmkphjz

Consider the following questions as a guideline:

- **When and where was she born?** Understanding her time period helps identify the challenges she faced.
- **What was her main invention?**
- **What problem did this invention solve?**
- **What impact did it have on society at the time?**
- **Did she face any obstacles in her career due to being a woman?**
- **What interesting facts about her stand out?**

CREATE

Some things you need before beginning

To use the three AI platforms recommended for this activity, each student needs their own email account.
Since the activity is short, it’s a good idea to have all three platforms open in advance to ensure a smooth workflow for the students.

For the teacher
To be fully prepared and make the most of Vidnoz, it’s recommended to watch these videos before the activity (subtitles available):

How to create a FREE avatar with AI | Vidnoz AI | Step-by-step tutorial:
https://youtu.be/wGShPRRrfXA?si=MIao0mfGpbd8JD9e

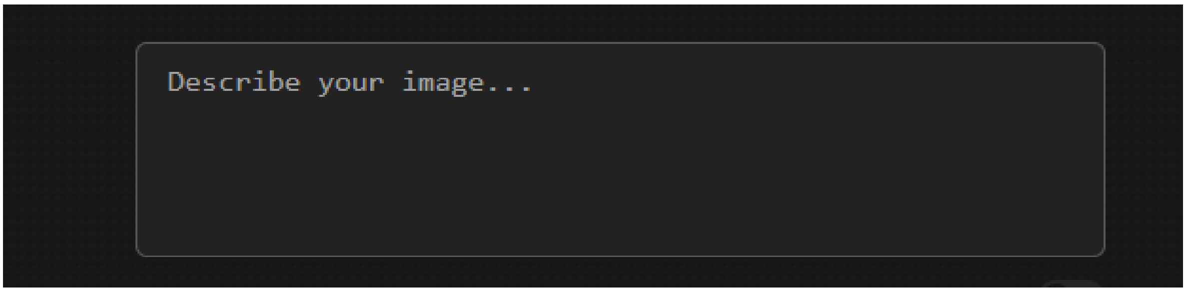
How to edit videos with Vidnoz AI 🎬| Free video editor with AI
https://youtu.be/jVTJNC3H8Hg?si=4gre14NIflOLf3Id

Vidnoz, the app for creating animated short films, offers a free version with access to many resources. However, this version limits the length of short films to a maximum of one minute.

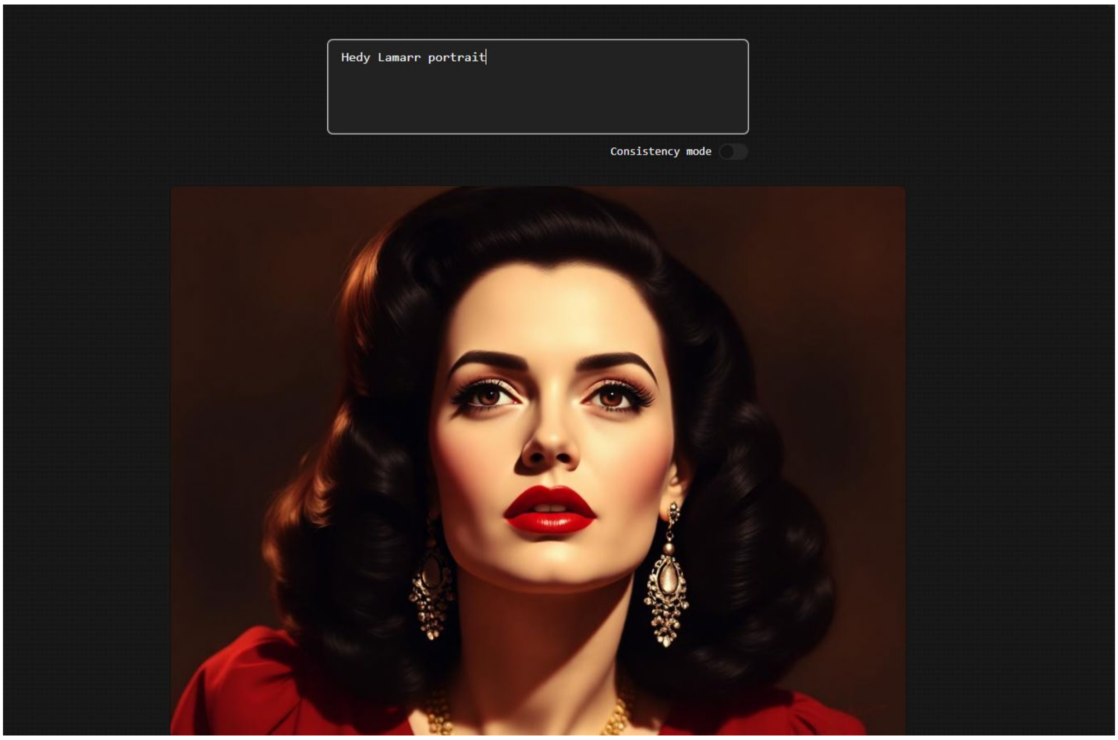
Now, follow these steps

1. Generate an image

Start by using the online AI art generator BlinkShot: https://www.blinkshot.io/to create a custom portrait of the inventor. This tool allows you to generate a portrait by simply inputting a text description.



For example, to create a portrait of Hedy Lamarr, simply type: *"portrait of Hedy Lamarr."* It's important for the image to be a frontal shot so that when it's time to give it a voice, the result will be as realistic as possible.

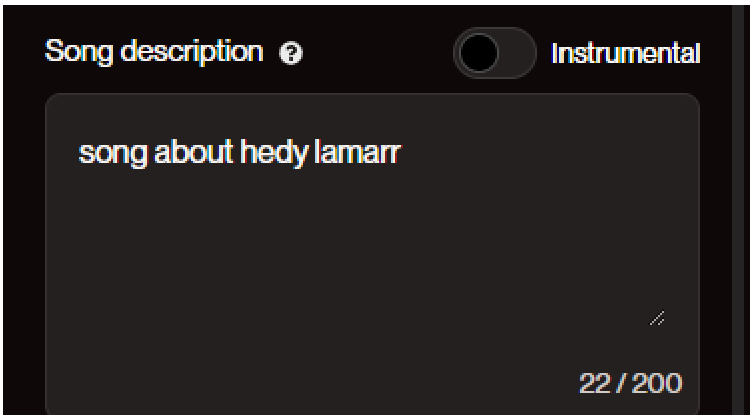


Once you have the image, save it to your computer.

Now that you know how to generate portraits with AI, you can also create images of their time period, their work, etc., to use as backgrounds in your animated short.

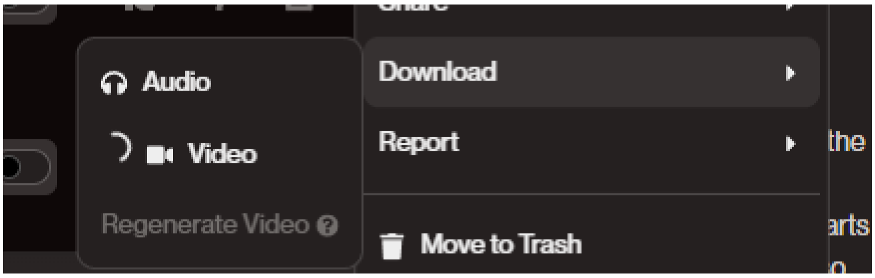
2. Generate a theme song

Now that you have your images, it's time to create a theme song for your short film. To do this, use the online application **Suno:** https://suno.com/, and enter a brief description of the type of song you want.



By toggling the **Instrumental** switch, you can choose whether you want the song to have lyrics or be instrumental only. In the description, you can also indicate your preferred musical style (pop, rock, etc.). When you click **Create**, several songs will be generated that you can listen to and choose the one you like best

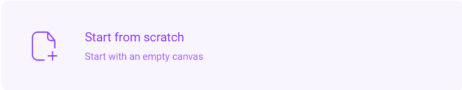
As the song plays, the lyrics will be displayed on the right side of the screen. Once you've selected the song that best suits your short film, it's time to download it. To do this, click on the three dots that appear to the right of the song and select **Download** and **Audio**.



3. Create an animated short

To create your video, go to the online application Viznoz: https://aiapp-es.vidnoz.com/index.html?name=ai and select at the top **Create Video**:

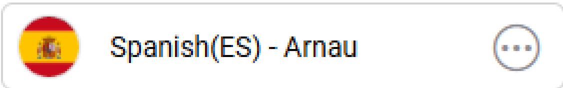
and then **Start from Scratch:**



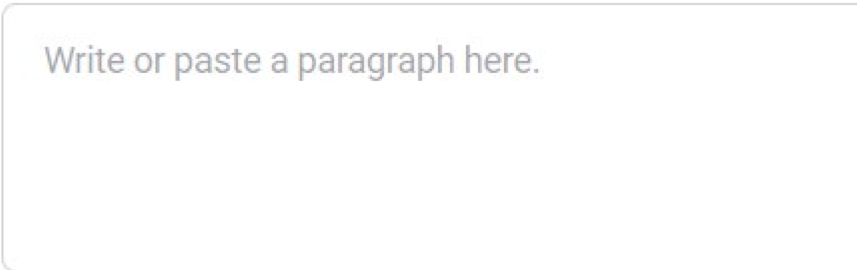
1. Add a background to your short.

2. Upload your inventor's IA generated portrait and choose the background removal option.

3. Choose your avatar´s voice.



4. In each scene, you should write the text you want the inventor to say. You'll do this by typing the dialogue at the bottom of the screen.



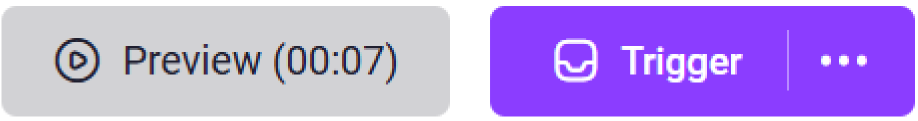
5. Add music or a soundtrack to your video.

6. Remember that the length of the video can't be more than one minute!

4. Creating your animated short:

To see how your video turned out, you can click on **preview**. Keep in mind that your inventor's avatar won't move her mouth until you **generate** the video, so do not think that's something wrong with your previous work.

Once you all have your animated short of your female inventor, it's time to show it to everyone else and discover everything these inventors have to tell you.



COMMUNICATE

Is time to share!

Don't forget to take a photo of your experience and share it with us!
#The_voice_history

- LinkedIn: https://www.linkedin.com/company/steambrace-project?trk=public_post_feed-actor-name
- Instagram: https://www.instagram.com/steambrace_eu/
- X: https://x.com/steambrace_eu

DESING AND KEEP ON LEARNING

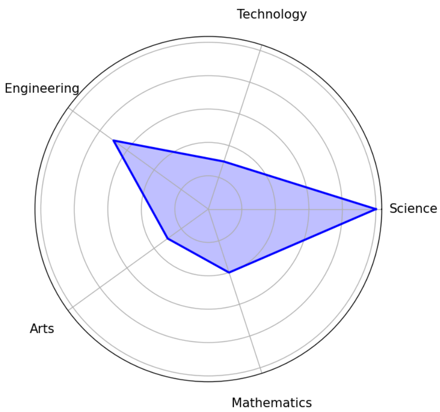
How can I make a similar project by myself?

Could you create something similar about an athlete or social figure you admire? Give it a shot!

Which are other connected projects?

Funded by the European Union

MOTORISING MAGNETS



DURATION	1 hr
AGE RANGE	13-14
DIFFICULTY	★★☆
TOPICS	SCIENCE EXPERIMENTATION

Description of the project

Have you ever wondered how electricity is ‘created’? How could we use it to our advantage? Could we use it to move things?

In this activity, we will learn how with natural forces such as magnetism and the conductivity of materials, we can create an electric motor almost by accident, and we will look at its fundamental characteristics.

Objectives: What will I learn?

- Conduct experiments on magnetic fields
- Conduct experiments on motors
- Apply knowledge of magnetism to build a simple motor

Materials: What do I need?

Activity kit:

- Disc magnets x3
- Copper coil 0,5mm
- Steel wool
- D-type battery
- Sandpaper
- Sieve

Provided by the teacher/institution:

- Lighter/9V battery or matches
- Sheets of paper
- Paper clips

Previous Preparation

- Have the materials ready for the practical activities on magnetic fields and motor construction
- Review the activity on magnetic fields

RESEARCH

Have a look at these resources

What do wipers, CD players, DVD recorders, blenders, ice machines, laptops, and walking toys have in common? They all use electric motors. In fact, if you look around your home, you'll find electric motors in many devices, appliances, and toys. Electric motors are everywhere and are a big part of our world today. Most of the mechanical movements you see are powered by an electric motor, either using alternating current (AC) or direct current (DC).

But have you ever wondered how electric motors work?
To understand, let's ask another question:
Have you ever played with magnets? If you have, you're already close to understanding the basics of how simple electric motors work.

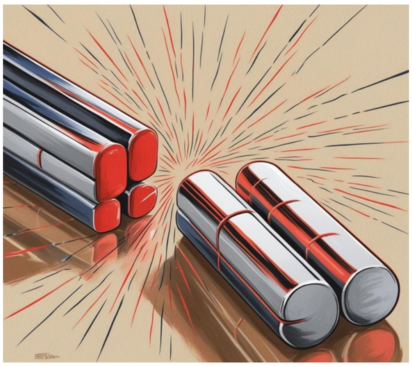
Electric motors create motion using magnets. If you've experimented with magnets, you might know their basic rule: **opposite poles attract, and same poles repel**.

Magnets have a north and a south pole, and they create an invisible magnetic field. If you try to push two north poles or two south poles together, they will repel each other. But if you bring a north pole near a south pole, they will attract and stick together.

In short:

- **Same poles repel.**
- **Opposite poles attract.**

The stronger the magnets, the stronger the attraction or repulsion between them.

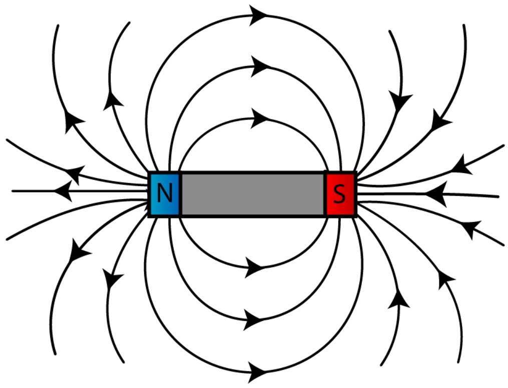


CREATE

Some things you need before beginning

Magnets and magnetised objects, like an electric current, generate a **MAGNETIC FIELD**. This field influences its surroundings, especially affecting those materials that are susceptible to magnetisation.

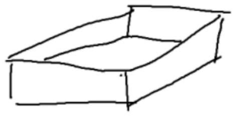
Magnets have poles where this field is 'born': it 'goes out' at one pole and 'comes back into' the magnet at the other. Normally you cannot see it, but we can draw it. For a rectangular magnet its magnetic field looks something like this:



Is it possible to look at these magnetic fields directly, beyond simply knowing that they exist because magnets attract each other?

The answer is YES, we can draw them.

We are going to make a box by folding an A4 sheet of paper.

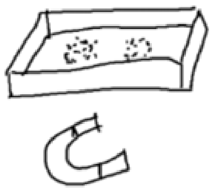


Distributing the iron filings:

- Gently tap the surface of the paper or plastic where the iron filings are spread. This slight movement allows the particles to settle and align with the magnetic field lines, revealing their invisible structure.

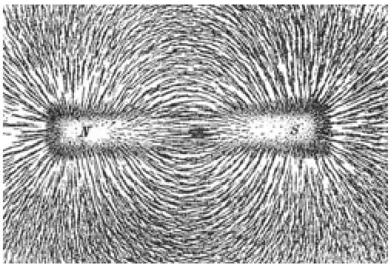
Exploring different configurations:

1. Place the magnets **underneath the paper or box** where the iron filings are spread.
2. Change the orientation of the magnets:
    - Experiment with different positions, such as facing like poles (north-north or south-south) or opposite poles (north-south).
    - You can also place two magnets together in different arrangements (aligned or at an angle).



3. Observe how the iron filings react:
    - Notice the new patterns that form depending on how the magnetic fields interact.

- Observe if the field lines connect (attraction) or diverge (repulsion).

- 

Source: https://es.wikipedia.org/wiki/Limaduras_de_hierro#/media/Archivo:Magnet0873.png

This method will help you better understand how magnetic forces interact and influence the particles.

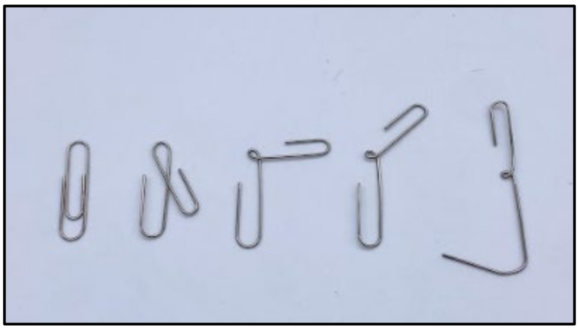
Now, follow these steps

Now, knowing that these fields exist, and harnessing the chemical energy of a battery, we will create our own **MOTOR**. We will learn how to build a simple electric motor and study how simple changes affect the rotation of the motor.

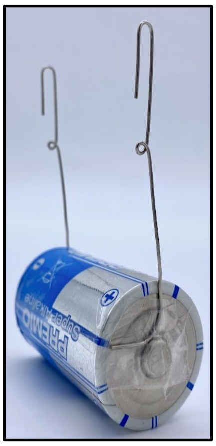
We will use the following materials:

Procedure:

1) Bend the clips to make supports for the wire.



2) Tape the clips to the ends of the battery.

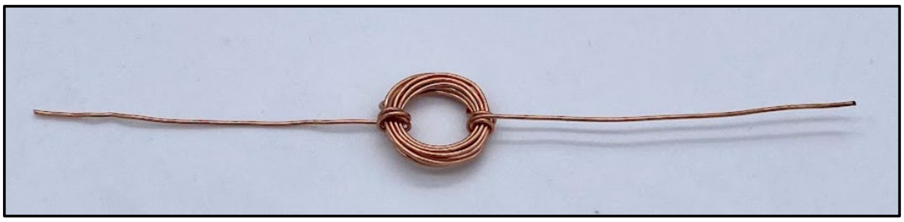


3) Wrap the wire around the marker 10 times to make a coil.

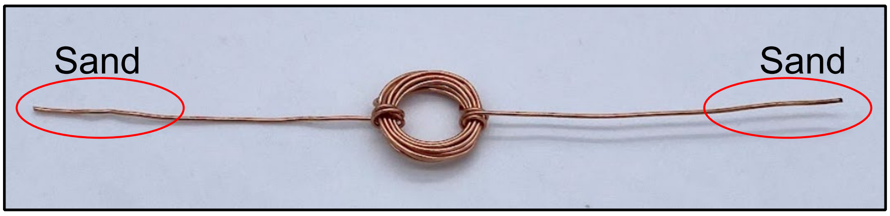
TIP

For the coiling part, it can be useful to make the turns of the coil on a pencil so that it keeps the round shape better.

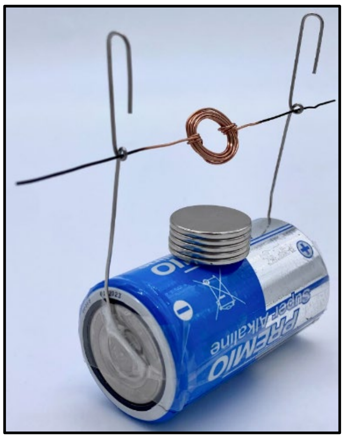
4) Cut, leaving about 3cm of wire at each end.
5) Wind the ends so that the coil keeps its shape.



6) Thoroughly sand the coating off one end of the wire, but not the whole end, just a portion of the terminals, as shown in the figure below.



7) Put the wire into the clip holders. Make sure that it can rotate freely. If not, adjust the shape of the wire.
8) Put the magnet underneath the coil - your motor may start running immediately! If not, give it a push to get it to start turning.



Change the amount of current or increase the number of wire turns to see what happens.

Discuss

How do you think the motor works, and what conclusions do you draw?
What happens if you change the number of magnets or the size of the coil?

COMMUNICATE

Is time to share!

We invite you to share your results on social media by tagging the STEAMbrace project: #Motorising_Magnets

- LinkedIn: https://www.linkedin.com/company/steambrace-project?trk=public_post_feed-actor-name
- Instagram: https://www.instagram.com/steambrace_eu/
- X: https://x.com/steambrace_eu

DESING AND KEEP ON LEARNING

How can I make a similar project by myself?

Can you change the speed of the coil? Try changing the current or increasing the number of wire turns to observe the effects.

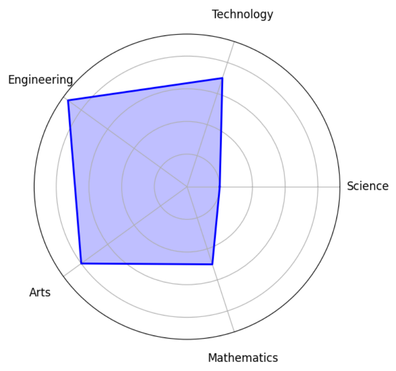
Create a paper propeller device and incorporate it to see how it moves. You can make the propeller by cutting a square piece of paper, folding it to form blades, and attaching it to a central point (like a straw or a stick). Then, try changing the current or increasing the number of wire turns to observe how it affects the movement of the propeller.

Which are other connected projects?

Based on the knowledge you've acquired, you can create another project where you light up a bulb by making a battery using copper and a magnet. Here's how you can do it.:
https://www.youtube.com/watch?v=MfHuK96YBug

STEAMBRACE
Funded by the European Union
Universidad del País Vasco Euskal Herriko Unibertsitatea
BILBOKO HEZKUNTZA FAKULTATEA FACULTAD DE EDUCACIÓN DE BILBAO
Academia de inventores

PACKAGING OF THE FUTURE



	DURATION	2 hr
	AGE RANGE	15-16
	DIFFICULTY	★☆☆
	TOPICS	ENGINEERING RESEARCH

Description of the project

In this session, students will explore the fascinating world of packaging design and technology. They will uncover the reasons behind the shapes, materials, and features of various packaging types and learn how cutting-edge technologies, including AI, are transforming the industry. These innovations allow for the development of adaptive, smart solutions tailored to the unique needs of products and consumers. By the end of the session, students will put their knowledge into practice by conceptualizing and designing their own adaptive packaging prototypes.

Objectives: What will I learn?

- Discovering Cutting-Edge Technologies
- Fostering Creativity and Innovation in Design
- Building 3D Design Skills
- Promoting Sustainability in Creative Solutions

Materials: What do I need?

Provided by the teacher/institution:

- Plastic bottle (Exercise 1)
- Measuring tools
- Computer equipment
- Examples of packaging (extra)

Downloadable elements:

- Packaging example

Previous Preparation

- Creation of working groups (2-3 participants)
- Preparation of materials
- Setting up accounts in teams to work with Tinkercad
- Configuration of equipment/devices
- Downloading of packaging examples if applicable

- As an extra, it might be useful to have examples of packaging in class.

RESEARCH

Have a look at these resources

With the rise of online sales, shipping volumes have surged, with an estimated 100 million packages shipped daily worldwide. Many parcels are oversized compared to their contents, prompting companies to seek more efficient solutions. Technologies like artificial intelligence (AI) now enable machines to create custom packaging tailored to each item, reducing material waste and improving sustainability.

Efficient Packaging Examples:

- **Soft Drink Cans:** Lightweight, recyclable aluminum cans with cylindrical shapes optimize storage and protect contents from light and air.
- **Tetra Bricks for Milk and Juice:** Multilayer designs combine carton, aluminum, and plastic for rigidity, protection, and sealing, making them space-efficient and reducing transport emissions.
- **Plastic and Glass Bottles:** PET plastic bottles are durable and lightweight, while glass bottles, though heavier, are fully recyclable and reusable. Both are designed for compact storage and efficient transport.
-

CREATE

Some things you need before beginning

The flat-bottomed paper bag. In 1867, Margaret Knight began working in a factory that manufactured paper bags. She noticed that the bags they produced were inefficient because they had an envelope design and were impractical for carrying items. This inspired Knight to design a machine that could produce bags with a flat bottom that are more stable and better able to transport products.

Knight spent months developing a prototype machine that automatically cut, folded and glued flat-bottomed paper bags. This design revolutionised the packaging industry, as the resulting bags were much more functional and useful for consumers and retailers.

In what context was this breakthrough achieved? In the second half of the 19th century, industry was booming in the United States, and the need for efficient and practical packaging methods was becoming increasingly apparent. Up to that time, paper bags had been impractical and could not stand upright, which limited their use.

What problems did he encounter after making his invention? In 1870, when Knight was about to patent his invention, Charles Annan, a man who had seen his machine in operation, tried to steal the idea and patent it in his name. Knight took Annan to court, and in a highly publicised trial, presented not only his drawings and sketches, but also testimony from people who had seen it working in his workshop.

The court ruled in Margaret Knight's favour in 1871, recognising her as the rightful inventor of the paper bag machine. This was a remarkable achievement, as few women of the time were able to patent their inventions due to gender bias.

Now, follow these steps

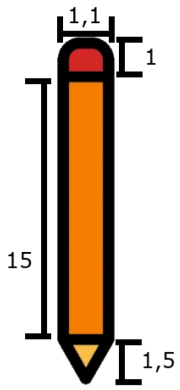
Step 1 - Decide which object you want to package

You will probably find many objects in your classroom that can be efficiently packaged. Decide which of these objects you want to package; in the example, the packaging of a pencil has been designed. It is a simple object that can be packed in a 'simple' way.

Step 2 - Take measurements of the object

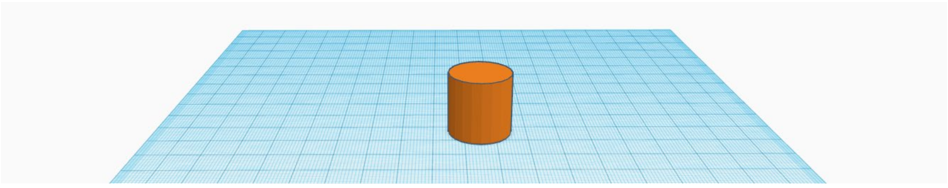
Once you have chosen the object, use tools such as callipers or rulers to record its measurements. Many packages have standardised dimensions, so you can also find standard measurements for many items on the internet.

In the case of the example, these would be the measurements:

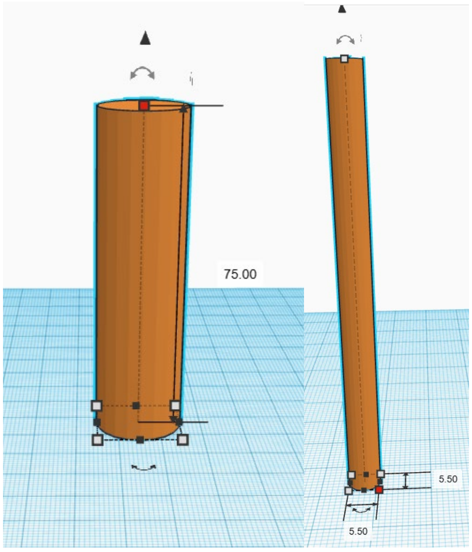


Step 3 - Model creation

Once the measurements have been taken, it is time to create a 3D replica. To do this, you must create a new 3D design in the Tinkercad platform (https://www.tinkercad.com/dashboard). Use the basic geometry blocks that you will find in the corresponding menu to create the replica.

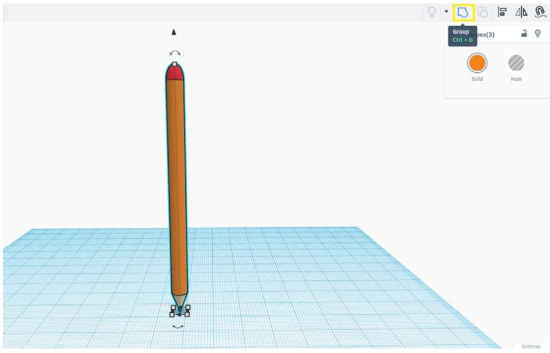


In the example, a pencil has been used as a reference. If your object is large, you can apply a scale to all its dimensions to maintain proportion and facilitate its design on the work table. For example, if you were working on packaging for a 100 x 50 cm painting, you could apply a scale of ⅕, transforming the design to 20 x 10 cm.

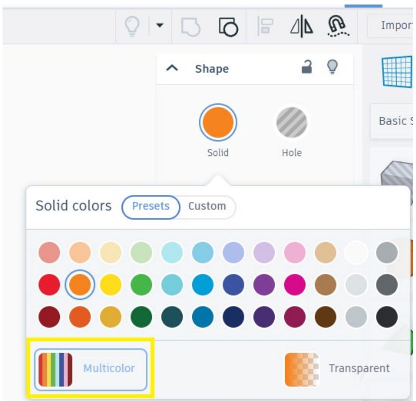


Step 4 - Design personalisation

Continue with the whole design and, when you have finished creating your object, you should join all the parts together so that it looks like a single piece. To do this, select all the parts at the same time and press the Group button.

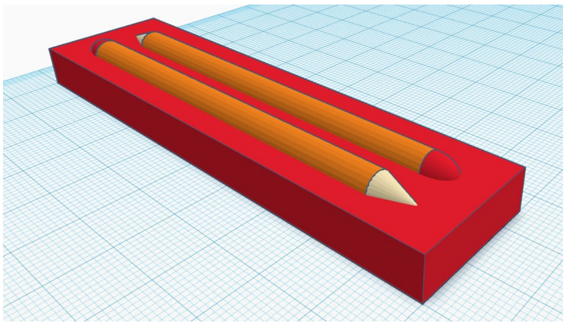


You may notice that, when you put the pieces together, the object becomes one colour. To avoid this and keep the colours you have chosen, you should select **Solid → Multicolour**. This will not turn your object into a rainbow, but each shape will keep the colour you have selected.



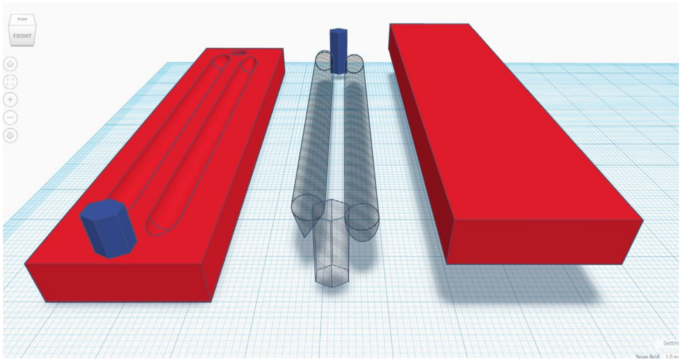
Step 5 - Creating packaging

Once you have your object ready, start thinking about the best way to design a packaging that will keep it perfectly fitted and can be closed securely. We recommend using a basic geometry as the basis for the packaging and applying the necessary subtractions to create the right space to accommodate the object. Once you have done this, you can customise the packaging and make any changes you consider necessary.

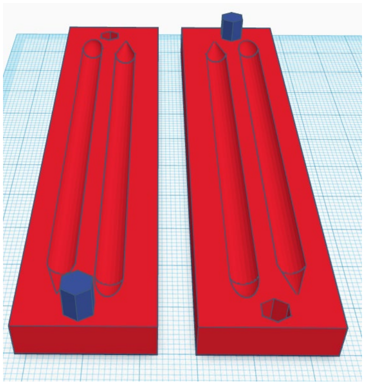


Step 6 - Volume subtraction

You can turn your object into a **'Hole'** to create its negative and design the space on the packaging where it will fit. It is also important to make sure that everything fits perfectly when you finish your design. Think carefully about how to make the lids and how to make the packaging stay securely closed.



On this occasion, some hexagons were added as a guide to join both sides of the packaging and close it securely.



Share the designs and ideas you have had with your colleagues.

COMMUNICATE

Is time to share!

We invite you to share your results on social media by tagging the STEAMbrace project: #Packaging_ of_the_future

- LinkedIn: https://www.linkedin.com/company/steambrace-project?trk=public_post_feed-actor-name
- Instagram: https://www.instagram.com/steambrace_eu/
- X: https://x.com/steambrace_eu

DESING AND KEEP ON LEARNING

How can I make a similar project by myself?

The packaging must include advanced features such as compartments, stackability, and display elements, while also incorporating sustainability through recyclable materials, biodegradable options, or reusable designs. Students will test their designs in real-world scenarios, evaluating durability, functionality, and efficiency. They will then present their work, explaining the process, challenges faced, and how the design addresses functionality, sustainability, and aesthetics, fostering critical thinking and creativity.

Which are other connected projects?

You can explore similar projects on the following page, where you'll find examples and tutorials on designing and customizing articulated boxes. These boxes enable you to experiment with simple mechanisms, such as integrated hinges or closures, combining functionality and creativity. Furthermore, this tool can help you create packaging that perfectly fits various objects, allowing you to experiment with practical and sustainable designs.

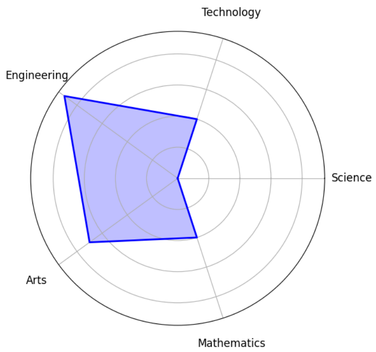
Funded by the European Union

Universidad del País Vasco Euskal Herriko Unibertsitatea

BILBOKO HEZKUNTZA FAKULTATEA
FACULTAD DE EDUCACIÓN DE BILBAO

Academia de inventores

ROBOT CAR



	DURATION	1 hr
	AGE RANGE	17-18
	DIFFICULTY	★★☆
	TOPICS	SCIENCE PROGRAMMING

Description of the project

Design and build a robot car using Arduino, combining electronics, mechanics, and programming. Once the components are assembled and the connections are completed, you will programme the car in the Arduino environment using graphical blocks, simplifying its configuration. Additionally, you can incorporate advanced design and programming features, tailoring the project to your specific needs and objectives.

Objectives: What will I learn?

- Develop practical skills in assembly and programming.
- Foster critical thinking and problem-solving abilities.
- Promote creativity and design in technological projects.

Materials: What do I need?

- 1 Motor controller
- 1 Arduino board
- 2 Motors
- 1 9-volt battery
- 1 wooden plank or flat support
- 1 swivel wheel
- Double-sided adhesive
- mBlock graphical block ecosystem: https://mblock.makeblock.com

RESEARCH

Have a look at these resources

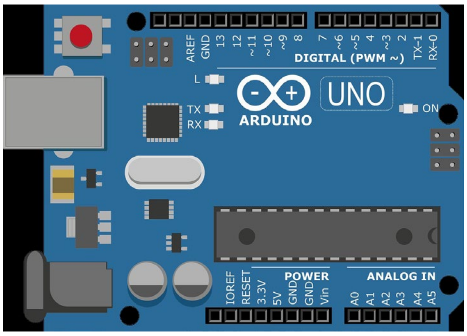
It is essential to analyse the available materials before starting the project, as this will determine the design of the car. This analysis helps in planning the placement of components, ensuring chassis stability, and distributing weight evenly, thereby guaranteeing efficient assembly and the proper functioning of the robot.

CREATE

Some things you need before beginning

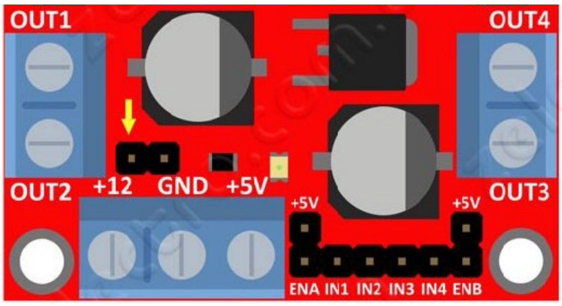
This is a diagram of an Arduino Uno with an explanation of its main components:

1. **Digital Ports (Digital I/O):**
   - Numbered 0 to 13.
   - Used for digital input and output (HIGH/LOW).
   - Some pins (3, 5, 6, 9, 10, 11) are marked with ~, indicating support for PWM (Pulse Width Modulation) to control motors, servos, or LED lights gradually.
2. **Analog Ports (Analog IN):**
   - Numbered A0 to A5.
   - Used to read analog signals from sensors, converting them into digital values.
3. **Power Pins (POWER):**
   - **Vin:** Input for unregulated external power (e.g., a battery).
   - **5V:** Regulated 5V output to power external components.
   - **3.3V:** 3.3V output for components that require lower voltage.
   - **GND:** Ground or reference pins (negative).
4. **Reset Button:**
   - Used to restart the Arduino, halting and restarting the programme loaded in memory.
5. **USB Port:**
   - Used to upload code from a computer and to power the Arduino during development.
6. **Power Connector (Jack):**
   - Allows the Arduino to be powered by an external source between 7V and 12V (e.g., a power adapter or battery).



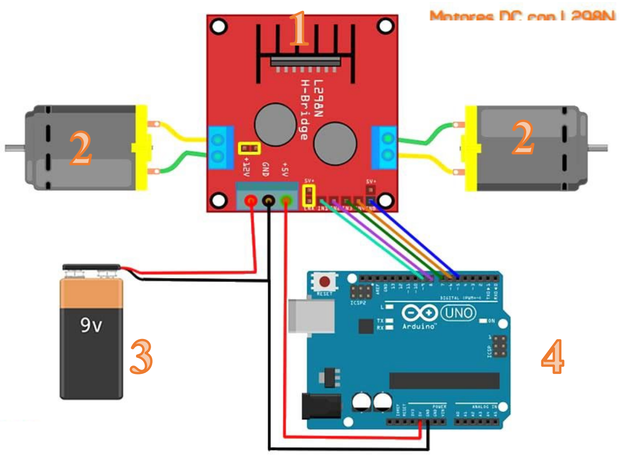
This is an L298N motor driver, used to control DC motors or stepper motors. Here is an explanation of its main components:

1. **Motor Output Ports (OUT1, OUT2, OUT3, OUT4):**
   - **OUT1 and OUT2:** Connection for one motor.
   - **OUT3 and OUT4:** Connection for a second motor.
   - These ports control the direction and on/off state of the motors.
2. **Power Ports (+12V, GND, 5V):**
   - **+12V:** Input for motor power supply (between 7V and 12V).
   - **GND:** Common ground for power and Arduino signals.
   - **5V:** Can act as an output (if the regulator is active) or as an input to power the driver.
3. **Signal Pins (ENA, IN1, IN2, IN3, IN4, ENB):**
   - **ENA and ENB:** Enable pins for the motors, connected to Arduino PWM pins to control speed.
   - **IN1 and IN2:** Control the direction of the motor connected to OUT1 and OUT2.
   - **IN3 and IN4:** Control the direction of the motor connected to OUT3 and OUT4.



Now, follow these steps

1. **Motor Driver:** Interprets the signals sent by the Arduino and safely and consistently distributes the power supplied by the battery to the motors.
2. **Motors:** Convert electrical energy into mechanical energy, spinning the wheels and providing motion to the car.
3. **Battery:** Supplies the electrical energy required for the entire system, especially the motors, enabling their operation.
4. **Arduino Uno:** Executes the programmed instructions, sending signals to the motor driver to coordinate the movement and behaviour of the prototype.



This is a basic diagram for connecting DC motors to the L298N motor driver using an Arduino board and a power source. Here's a step-by-step explanation of the setup:

1. **Connect the DC Motors to the L298N Driver:**
   - Each DC motor has two wires (positive and negative).
   - Connect the wires of the left motor to the OUT1 and OUT2 terminals of the L298N.
   - Connect the wires of the right motor to the OUT3 and OUT4 terminals of the L298N.
2. **Connect the Power Source to the L298N:**
   - Connect the 9V battery to the L298N terminals:
     - Terminal **+12V** for the positive wire of the battery.
     - Terminal **GND** for the negative wire of the battery.
   - This will power both the driver and the motors.
3. **Connect the L298N to the Arduino:**
   - Use wires to connect the control pins of the L298N to the Arduino's digital pins:
     - **IN1** and **IN2** to control the left motor.
     - **IN3** and **IN4** to control the right motor.
   - Also, connect the **Enable A** and **Enable B** pins (if required) to the Arduino's PWM pins to control the motor speeds.
4. **Share the Ground (GND):**
   - Connect the **GND** pin of the L298N to the **GND** pin of the Arduino to ensure both share the same ground reference.
5. **Check Connections:**
   - Ensure all wires are properly connected and there are no short circuits.
6. **Upload the Program to the Arduino:**
   - Write or upload a program in the Arduino IDE to control the signals for the **IN1**, **IN2**, **IN3**, and **IN4** pins. For example, you can programme the car to move forward, backward, and turn left or right by sending HIGH/LOW signals to these pins.
7. **Test the Setup:**
   - Connect the battery and the Arduino. Ensure the motors respond according to the programmed instructions.

COMMUNICATE

Is time to share!

We invite you to share your results on social media by tagging the STEAMbrace project: #Robot_Car

- LinkedIn: https://www.linkedin.com/company/steambrace-project?trk=public_post_feed-actor-name
- Instagram: https://www.instagram.com/steambrace_eu/
- X: https://x.com/steambrace_eu

DESING AND KEEP ON LEARNING

How can I make a similar project by myself?

An alternative model of the robot car can be designed with a unique layout and a customised chassis using materials such as wood, plastic, or aluminium. Larger wheels, omnidirectional wheels, or wheels suitable for uneven terrain can be added. This flexibility allows for adjustments to the size, shape, and the addition of extra features based on the specific needs of the project.

Which are other connected projects?

Here is an example of other projects that can help you in your development:

Creating a line follower robot using an Arduino is a popular robotics project. It utilizes infrared (IR) sensors to detect and follow a line on the ground, usually a black line on a white surface or vice versa. Below is a step-by-step guide to build a simple line follower robot using an Arduino, IR sensors, and a motor driver (such as the L293D).

https://projecthub.arduino.cc/lee_curiosity/building-a-line-following-robot-using-arduino-017dbb